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AVIATION
FOR JANUARY 1933

1932 passes into history

Closing months of a lean year show promise for the future

SOME YEARS GO down in history as periods of fulfillment, while others furnish mainly background for the future. As this particular year closes there seems to be reliable indication, for the first time in many months, that that elusive and long awaited turning-point has been reached.

Efficient management has done much to stem the tide of red ink, and black figures are beginning to appear sporadically. The production ground-hog has emerged from his deep sleep, yawned, and seeing no shadow of surplus stocks has decided to remain awake. He has found interesting material with which to work in the series of designs conceived in 1932. The quantitative aspect of his plans is discussed in the prophetic portion of this issue. His prospects have been enhanced by the far-sightedness of the merchandising talent of the industry, which has been looking southward and across the seas toward markets born of the military demands of certain nations of South America and Europe. While production is reviving, transport continues to grow at a rate that is amazing in the light of the present economic chaos. Operators have responded to ever-increasing popular demand by increasing the real service rendered to the public for every dollar received, a time-worn and reliable formula for success, and have made their existence felt by their competitors. Wise rivals are accepting the decree of Progress and co-operating; foolish ones, continuing cut-throat methods, are waging a losing battle against natural law.

With the passing of the romantic era comes a changing attitude toward the public relationships of aeronautics as a whole. Such time-worn institutions as the National Aircraft Show, National Air Races and National Air Tour have been definitely affected. This year's experience has indicated that neither the show nor the races, as organized in the past, exactly meet the diminishing demands of a deflated industry, and there is a widespread belief that in 1933 the show will be omitted and the races curtailed. The National Air Tour has already fallen by the wayside and, for the first time in many years, was omitted in 1932.

Early in January, 22 privately owned planes started from Hicksville, L. I., for Miami, Fla., on a cruise sponsored by the Amateur Air Pilots' Association. In spite of very unfavorable weather, eight finished on time and others later. A successful seaplane cruise was held on Long Island Sound under the same auspices during the summer.

And so the industry, girded with its newly acquired armor of economy and efficiency, and a wealth of experience, sets forth, Congress willing, to new conquests under a new administration.

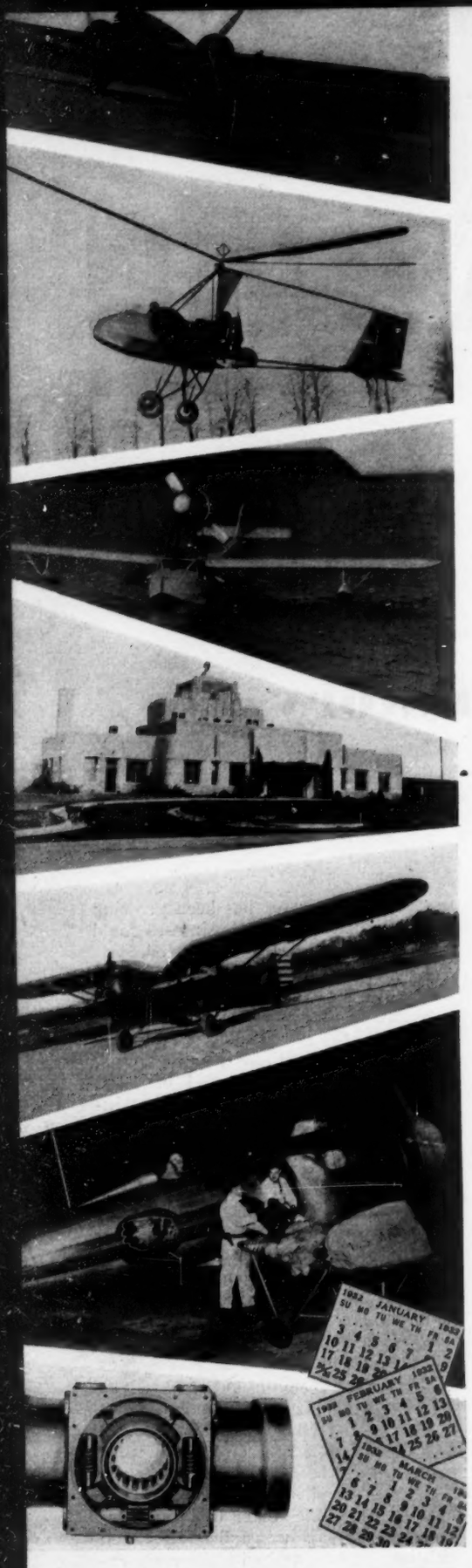
Transport

While other transport agencies, divided against themselves, expended their diminishing resources and the public money in their struggle for existence, air transport has been growing at a rate that few other businesses could equal during the depression period.

Comparing the first nine months of 1931 with the same period in 1932, the passenger miles flown increased from 89,928,195 to 107,804,869. An even greater gain was shown in air express. In the nine months' period of 1931, 683,845 lb. were carried. This has increased for the same period in 1932, to 1,019,973 lb.

Throughout the year there has been a general downward trend of air fares. Beginning early in January, several of the major operators instituted fare reductions of 10 to 20 per cent, bringing their average fare to approximately 6.2 cents per mile. At the peak of the summer business, a $5 student fare from New York to Washington, subject to empty seats on selected schedules, was tried by the Ludington Line. The practice of selling tickets in quantities at a reduced rate also was instituted.

Decreases in actual city-to-city time through increased service, co-ordination of schedules and improved ground connections has done much to bring passengers to the airlines, and co-operation with bus systems and with the more enlightened railroads has also contributed. Through coast-to-coast service with night departures and running time of slightly more than 24 hours has been put into effect, and still more rapid service is promised for the immediate future. Night schedules have been very heavily patronized.



Top to bottom: Twin engine Martin bomber. Buhl pusher type autogiro. An enclosed version of the Amphibions Privateer. Air terminal at Tulsa, Okla. The Douglass XB-7 bomber. Loading the night mail. The Smith controllable pitch propeller hub.

Distribution of airline tickets has been expedited through co-operation with bus operators and telegraph companies. A central air ticket office has been experimentally established in New York by the Postal Telegraph Company.

Independent airline operation suffered a severe blow when E. L. Cord decided to cast his lot with the mail contractors and, through an ingenious series of moves, gained control of the Aviation Corporation. The first step in the strategic sequence was the sale of Century Airlines to the Aviation Corporation, in April, in consideration of approximately 140,000 of the 183,683 shares of stock then held by the Aviation Corporation treasury. That was followed by the gradual acquisition of stock by the Cord interests up to 25 or 30 per cent of the total of 3,000,000 shares in the closing months of the year. The next move was made by the management, which attempted to acquire a large part of the assets of North American Aviation in exchange for Aviation Corporation stock, which would have diluted the Cord interests appreciably. In the ensuing fray, Mr. Cord came out on top, as reported in detail in the News Section of this issue.

Labor difficulties entered the air transport picture early in 1932 when Century Airlines introduced a wage readjustment to which the pilots and certain executives failed to agree. After a month of upset schedules due to a strike or lockout, substitute crews were recruited and trained while the dispute was carried to Congress and the Chicago City Government, accompanied by a flood of publicity from both forces. The dissatisfaction was settled automatically by the sale of Century, but it had the indirect effect of welding the pilots on all lines together with a new sense of their common interest and strengthening their association.

On July 10, following an agreement between seven major airlines, the first unified independent air express system began operation under the name of General Air Express. The arrangement provided a uniform waybill for shipments operating over these lines and provides door-to-door service on shipments up to 200 lb. through co-operation with Postal Telegraph. Another group of airlines has sworn allegiance to the Railway Express Agency, and operates under a system of train-plane co-ordination, utilizing the existing express pick-up and delivery facilities. Substantial reduction in rates was put into effect in December by the Railway Express Agency, following another reduction early in the year.

The air mail rate was raised on July 13 to 8 cents for the first ounce or fraction thereof, and 13 cents for each additional ounce. A 30 per cent drop in air mail poundage resulted.

There has been a continuous downward trend in air mail contract rates as a result of various revisions made by the Post Office Department during the year. Congressional investigations are in hourly prospect.

Design and construction

Although the primary emphasis of 1932 design effort was on transport types, a number of new ships for sportsman pilots appeared. Very few of the ultra-light variety were in evidence. The trend was rather toward medium-weight, medium-horsepower designs, many arranged for side-by-side seating, with complete enclosure ranging in style from the demountable "winter top" introduced by Waco and Kellet, to cabin types typified by the Fairchild 24, the Stinson R, the new Privateer, and the Beechcraft. Beechcraft embodied negative stagger and a split rudder air brake. The 1932 Privateer hull employed a welded steel tube framework, dural bottom, and heavy canvas sides.

In transport design, the year 1932 will be remembered as a turning point for operators have generally realized that economy lies in the direction of replacing 1928-1929 designed equipment with something more suitable to 1932-1933 requirements. The only transport machine which actually put in an appearance during the year was the Stinson Model U., but General Aviation, Lockheed, Vultee, and others have high-speed single-engined, low-wing monoplanes completed or in various stages of construction, the Boeing transport is soon to be flown, and Curtiss-Wright is completing a new Condor, with air-cooled engines. Sixty of the Boeings are on the way for United.

Maintenance men as well as designers, have been consulted in the laying out of new transport ships, and in many cases a complete maintenance specification has been written for the guidance of the builder. Limiting man-hour allowances have been tabulated for maintenance operations. (See AVIATION, January, February, 1932).

A number of retractable landing gear designs are in evidence or in prospect. A semi-retracting design was used on Beechcraft and the Ford giant, and a retractable beaching gear on General Aviation's Antares for the Coast Guard.

The failure of the big Ford A-14 to appear and the almost universal adoption of ten to twelve seats as the maximum for the new transports indicates a trend away from the 1930-31 idea of super-transports.

Practically all of the new transports have been studied from the standpoint of maximum freedom of movement for passengers, both with respect to headroom and seating arrangement. Pilot-controlled heating and ventilating systems are also the vogue, and a great deal of attention has been paid to noise-reduction in cabins, both through re-

duction of propeller tip speed by engine gearing and by cabin-wall insulation.

Power plants

Interest in engines of small horsepower, so noticeable during 1931, has practically evaporated during the past twelve months. Whereas five of the eleven A.T.C.s issued in 1931 were for engines under 60 hp., not a single one of the 16 A.T.C.s in 1932 have been below the 150-hp. class. The trend has been toward the opposite extreme, for eight of the sixteen are rated at 375 hp. or better.

Without exception all engines approved during the year have been air-cooled, and with only one exception (American Ranger, inverted twelve-cylinder V) all have been radial types. Horsepower ratings have been advanced by increasing supercharging and by advancing compression ratios.

Diesel progress has been steady but slow. Minor improvements have been announced by Packard, and several new engines have appeared. Pratt & Whitney introduced a direct injection Hornet which burned anything from furnace oil to gasoline on flight tests. Hydrogenated or so-called "safety" fuels, after several years of laboratory testing, have been placed on the market for commercial use. Double-row or "twin" radial engines which were in the rumor stage at the end of 1931, materialized in 1932.

Liquid-cooling still holds its own in the Air Corps, but appears to be losing its slender grip on the transport field. The Curtiss Conqueror, as the single active representative of the liquid-cooled class, appeared during 1932 in new geared and supercharged form.

The combination of forged aluminum blades and forged steel hub is still standard for propellers, although there has been a marked interest in the development of hollow steel blades. Controllable pitch devices have come to the fore again, and a number of practical models have been made available. The world's landplane speed record was made with a controllable pitch propeller.

Progress in research

With respect to aerodynamic research, the year 1931 was a starting-point for bigger and better things due to the installation during that period of vastly improved facilities at the N.A.C.A. laboratories at Langley Field. The value of the full-scale tunnel in solving specific design problems has been demonstrated, and an intensive program of investigation of seaplane floats and hulls is now under way in the new towing basin. In general, the year's work of the N.A.C.A. has been devoted to improvement in aerodynamic efficiency, safety in flight, and improvement in design and operation. In spite of adverse business conditions the seventh annual conference of the N.A.C.A. with representatives of the industry was well attended and great appreciation was expressed by the industry for the committee's valuable work.

Both laboratory and flight tests have been conducted on spinning, and in methods for the control of aircraft at low speeds. In this connection, a number of high lift wing devices, both fixed and movable, have been investigated. A great deal of work has also been done in the wind tunnel on the interference drag of nacelles in the neighborhood of monoplane wings, and it has been determined that the optimum propeller hub location, both from the standpoint of minimum drag and high propulsive efficiency, is in line with, and 25 per cent of the chord ahead of the leading edge.

Flight studies have been continued on accelerations with new instruments, and a great deal of light has been shed upon the distribution of loads under various conditions.

Power plants have come in for their share of attention. Cylinder scavenging, direct injection, two-stroke cycles, and detonation have been investigated, as well as the effect of using the so-called safety fuels and their relationship to the fire hazard in airplanes. In connection with drag reduction experiments, much has been learned about the shape and location of cowling, and its effect on engine temperatures. The Diesel problem has not been neglected.

In the field of materials, investigation has centered on the aluminum-silicon alloys and the aluminum-magnesium alloys as applied to aircraft. The general adoption of stainless steel has not come about as rapidly as was predicted at the end of 1931, but progress is being made. The difficulties which were experienced with machining and welding have largely been overcome by improved composition control. Corrosion control continues to be of first-rate importance. An outstanding development has been a discovery that a Bakelite varnish pigmented with 300-mesh aluminum powder is especially effective to resist severe exposure conditions.

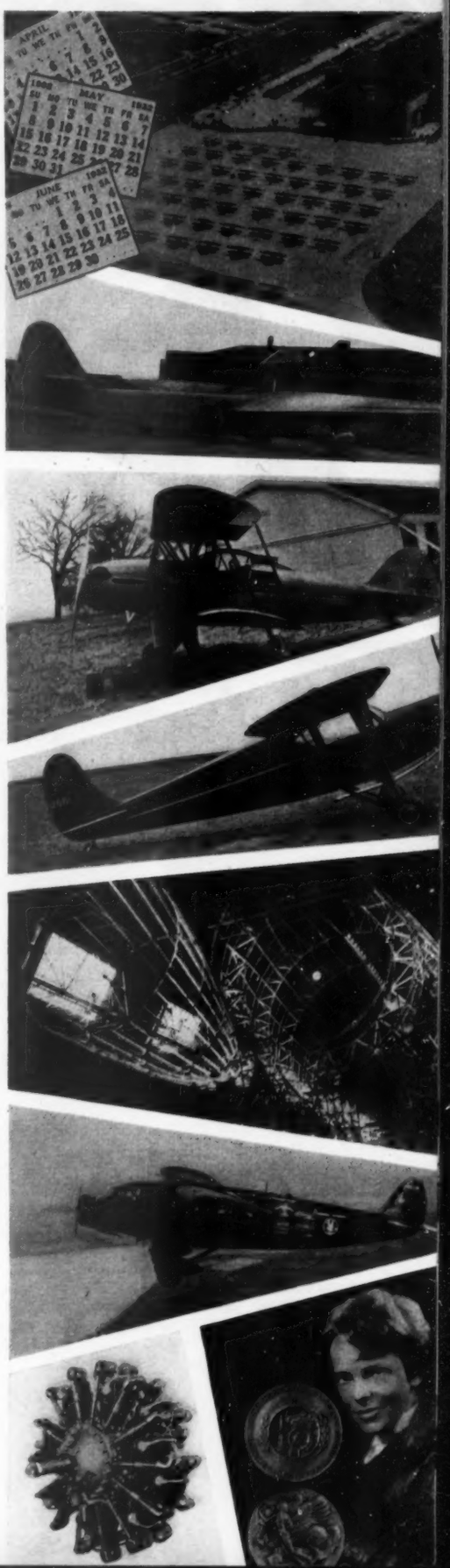
A great deal of theoretical and experimental work has been conducted in connection with the construction of metal monocoque fuselages. Extensive tests have been run on typical assemblies of various types.

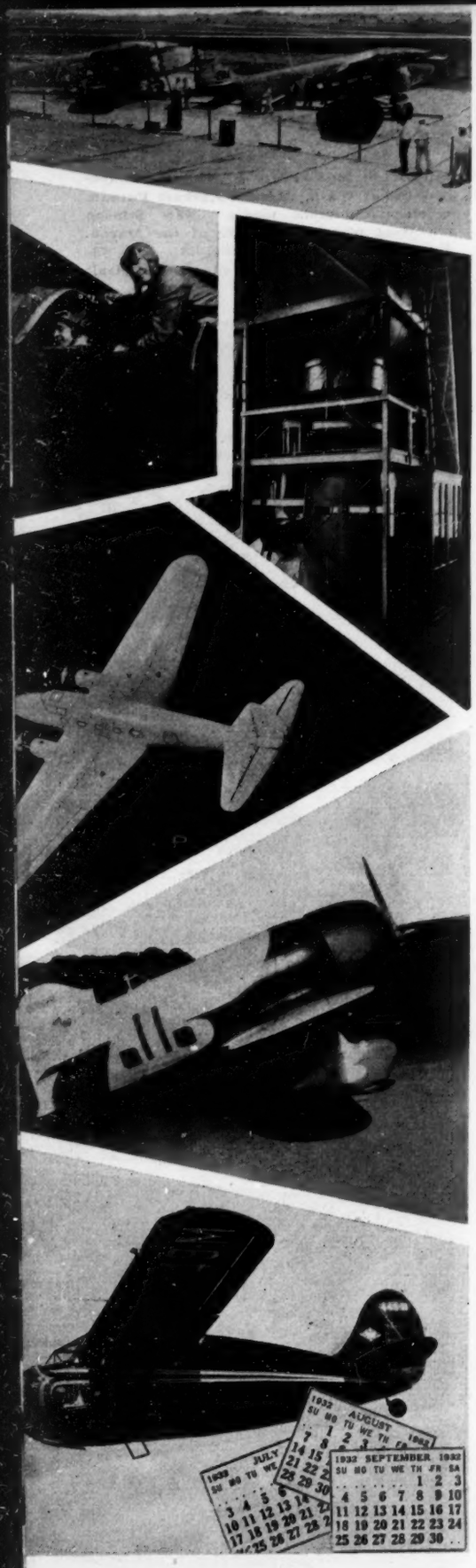
Outstanding among the work of other laboratories is a study of the effect of fillets on wing-fuselage interference made at the California Institute of Technology for Northrop (see page 25).

Autogiros

As 1932 closes, approximately 70 autogiros are in daily service for a wide variety of purposes, among which are advertising, commutating, prospecting, forest fire control, police work and

Bottom to top: Pratt & Whitney Double row radial Wasp. Amelia Earhart Putnam receives Columbia medal. New Stinson transport plane. Structure of the Macon. Fairchild 24. Waco Model A. The 32-passenger Ford. Army planes visit Detroit Show.





Top to bottom: The first inter-airline exchange of cargo by General Air Express. Blind flight instruction. The N.A.C.A. vertical tunnel. Artists conception of Boeing Transport. World's fastest lanplane. Retractable gear Stinson Model R.

shuttle service. Performance has been steadily increased.

The latest Pitcairn machine, the PA-19, is a four-place cabin-type, employing tapered cantilever wings, faired undercarriage, and enclosed streamlined pylon. The Kellett Aircraft Corporation of Philadelphia brought out its K-3 with side-by-side seating arrangement and fully equipped with a detachable coupe top. A pusher type giro was developed and flown by Buhl in the early spring, and a number of extensive flight tests were made in the feathering-blade Wilford Gyroplane.

Airships

Many thousands of miles were covered and hours of experience were accumulated in the operation of lighter-than-aircraft during 1932. The flights of the U. S. S. Akron and those of the Graf Zeppelin have been watched with interest by various advocates of trans-oceanic dirigible service.

The U. S. S. Macon, sister-ship of the Akron, but 8,000 lb. lighter, approached completion. The Goodyear - Zeppelin Corporation has under construction for the United States Army the largest non-rigid airship ever built in this country. This ship, the TC-13 will have a gas capacity of 365 cu.ft. with a gross lift of 22,300 lb., a length of 233 ft., and a diameter of 54 ft. Diesel engines were installed in the Goodyear Defender during 1932, and tested.

The International Balloon Race starting at Basle, Switzerland, Sept. 25, resulted in the victory for the United States Navy Balloon Pilots, by Lieut. Comdr. T. J. W. Seattle.

Naval aeronautics

Fleet aircraft participated in all maneuvers and concentrations during the year, operating under all conditions encountered, including some unusually bad weather. The outstanding features were the development and use of faster scouting and fighting planes, the use in long-distance patrol of planes based on tenders and on fleet air bases, and the increased use of catapult-launched planes for cruisers and battleships. The patrol squadrons were very active throughout the year. Extensive use has been made of the Akron. On June 30 the Los Angeles was decommissioned as an economy measure.

Due to failure of enactment of the bill submitted to the last Congress providing 114 airplanes for the new aircraft carrier, U. S. S. Ranger, the Navy must provision that ship within the 1,000 airplanes now authorized. The program for turn table powder catapult installation on the quarter decks of all batteships has been completed.

As a result of successful trials of experimental models, the first airplanes designed as dive bombers, and the first fighters for use on airships were ordered for service. A fast experimental two-seater fighter with retractable landing gear passed successful tests, and is being developed for service.

The development field of experimental power plants has been narrowed to conform to the very definite and current needs of naval aviation. The power output of existing service types of engines has been increased by about 10 per cent for the same piston displacement. Endurance testing of 150 hours is now specified. Upward revision of the specifications for fuels and lubricants have been made to take advantage of the refining advances.

An improved standard cost accounting plan has been placed in effect at overhaul bases. Comparison of costs and adoption of the most efficient overhaul practices now becomes possible.

Researches are under way to provide the service with a satisfactory, quick-attachable parachute, and several types are undergoing service tests. Many new instruments have been developed.

Army Air Corps

The practice of rigid economy in Army Air Corps expenditures has resulted in a saving of more than two million dollars, which were returned to the Treasury. This has necessitated postponement of the completion of the Air Corps Five-Year Program and the net result is that the air component of the Army is short 129 airplanes of the 1,800 serviceable airplane objective set forth by the Five-Year Program. Of the 379 new airplanes procured or contracted for during the fiscal year 1932, the large majority were tactical types, only 36 training type airplanes being included for service tests.

These procurements included initial service test qualities of the new type bombardment, attack and observation planes having performance far exceeding that of any previous similar types, and procurement for the fiscal year 1933 will be devoted to such airplanes of this group as may prove satisfactory in service tests. Practically all of the new improved airplanes are monoplanes embodying metal construction.

A wide range of projects was carried on in the field of research. In addition to the experimental work in connection with the previously mentioned improved designs, tests were conducted on a low-wing metal monoplane for pursuit service. It is hoped that a great spur to pursuit development will result.

Work of importance not only to the Army, but to the established airlines as well, has been done in aerial navigation, with particular attention to the problems of fog flying and blind landing.

Record flights

Highlight of 1932 was a brief speed trial by Maj. James H. Doolittle, breaking the one world's record which had

resisted all attack during almost eight years, that for landplane speed. He flew a Wasp-powered Gee Bee Super sportster four laps over the F. A. I. prescribed three-kilometer course at an average speed of 294.39 m.p.h., 15.91 miles faster than the record set by Officer Bonnet of France in 1924.

Capt. Cyril Uwins in a Vickers Vespa with Bristol Pegasus engine raised the world's altitude record for airplanes to 43,976 ft., 800 ft. above the ceiling reached by Lieut. Apollo Soucek of the U. S. Navy in June, 1930. In his hydrogen-filled balloon Prof. August Piccard rose almost two miles higher, to better by 1,620 ft. the absolute altitude record set by him at 52,500 ft. in 1931. Lucien Boussotrot and Emil Rossi regained the world's closed circuit distance record taken from them by two other French pilots, Le Brix and Doret, in July, 1931. Flying a triangular course over Oran, Algeria, their Bleriot-Zapata with 600-hp. Hispano-Suiza engine covered 6,600 miles without refueling, almost 1,600 miles further than the Boardman and Polando straight line record.

First across the Atlantic when the season for ocean flying opened was Amelia Earhart Putnam, establishing a new trans-Atlantic speed record of thirteen hours, 30 minutes. Not many weeks later another Lockheed Vega with Wasp, flown by Mattern and Griffin, cut the trans-Atlantic time to ten hours, 50 minutes. Capt. Wolfgang von Gronau and three companions circled the world between July 22 and Nov. 9 with no greater mishap than a landing in the Bay of Bengal because of a broken water pump. The wandering DoX, which left its Lake Constance home early in 1931 climaxed its nineteen-months trip around the rim of the Atlantic with a sixteen hour, 55 minute flight from Holyrood, Newfoundland, to the Azores, whence it continued directly to Germany. James A. Mollison, flying his tiny Puss Moth from Portmarnock, Irish Free State, to St. John, N. B., accomplished the first solo westerly crossing of the North Atlantic.

Over the popular England-Capetown route (6,000 miles) early in the year Mollison flew at a new fast time of four days, seventeen and a half hours. In December Mollison's time for the trip was cut more than ten hours by his wife, Amy Johnson. The French pilots Goulette and Salel flew from Le Bourget to Capetown in three days, nineteen hours, fifteen minutes. The England-Australia record changed hands when C. W. R. Scott in an eight-day-eighteen-hour-53-minute-flight regained the title taken from him by C. A. Butler in November, 1931. Another outstanding distance flight was made by a Couzinet tri-engined monoplane, covering the 13,300 miles between France and New Caledonia in fifteen flights, six of them more than 1,000 miles long.

James Haizlip and his Wedell-Williams monoplane with Wasp Junior took the eastward transcontinental record from Major Doolittle in a ten-hour, nineteen-minute dash from Los Angeles to New York with stops for refueling. Later Col. Roscoe Turner in another Wedell-Williams with Wasp set a new record for the flight in the opposite direction, cutting two hours, seventeen minutes from Capt. Frank Hawks' 1930 time of fourteen hours, 50 minutes. In yet a third Wedell-Williams plane (with Wasp Junior) a record flight between Ottawa and Mexico City, via Washington, was made by its designer and builder, James Wedell. He cut 43 minutes from the time of Major Doolittle, who last year linked the three capitals in twelve hours, 36 minutes.

Airports

Airport development in 1932 was painfully slow but two projects stand out as highly important. Construction at Barksdale Field, Shreveport, La., was virtually completed by the Army Air Corps to accommodate the attack wing. Among the commercial fields, is Shushan Airport, New Orleans, which is constructed on a filled-in area off the shores of Lake Pontchartrain.

Gliders

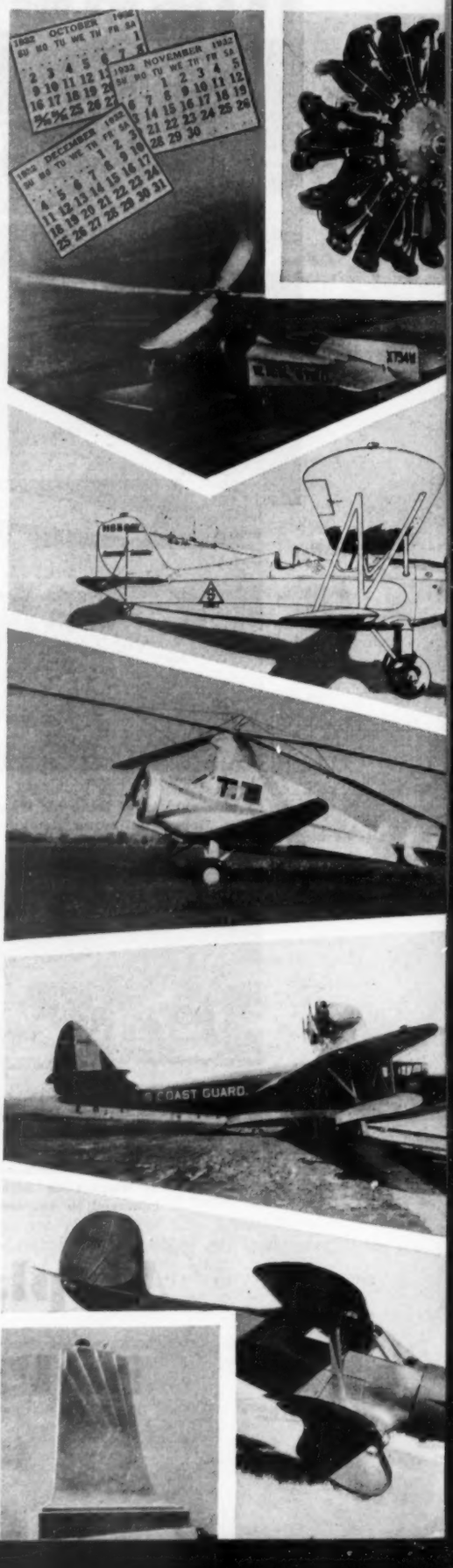
The Haller-Hirth group in Pittsburgh operated a gliding school at the new county-city airport in Pittsburgh and imported a number of models of the Haller Hawk and Hawk Junior from Germany.

The Glider Section of the Aviation League of Rhode Island trained a large number of pilots and extended its enthusiasm throughout New England via the New England Glider Association. Another very active training center was the school operated at the Norwich (N. Y.) Airport by Warren Eaton, president of the Soaring Society of America. Soaring was accomplished at a number of points, chiefly Elmira.

The first successful soaring meet to be held in this country was staged by The Soaring Society of America at Elmira July 11-24. With more soaring and more entries than ever before and without a single injury the meet marked the advent of a new era in soaring flight in this country. Six sailplanes, sixteen utilities, two two-place models and 45 pilots participated in 153 soaring flights from ridges.

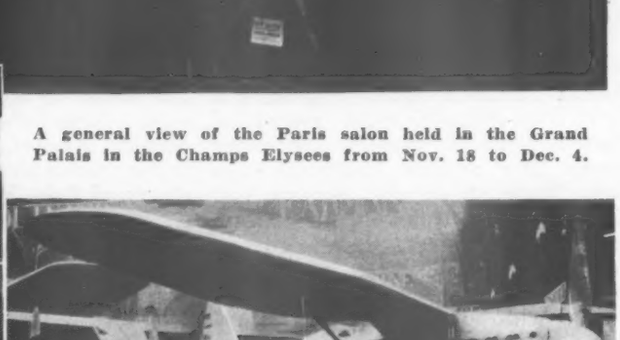
As the year closed the Soaring Society was working with Elmira citizens on a plan for establishing a permanent soaring camp at Elmira for the sake of providing adequate facilities for training and for enjoying the sport at all times of the year.

Bottom to top: The Wright memorial at Kitty Hawk. Whirlwind powered Beechcraft. General Aviation's "Antares" Coast Guard Flying boat. America's first cabin autogiro by Pitcairn. Stearman custom Sportster for 1933. Wilford Gyroplane. Model F Wright Cyclone.

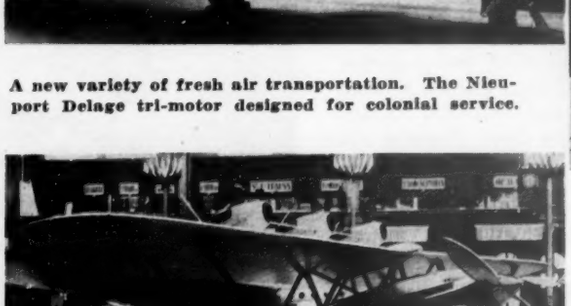


A general view of the Paris salon held in the Grand Palais in the Champs Elysees from Nov. 18 to Dec. 4.

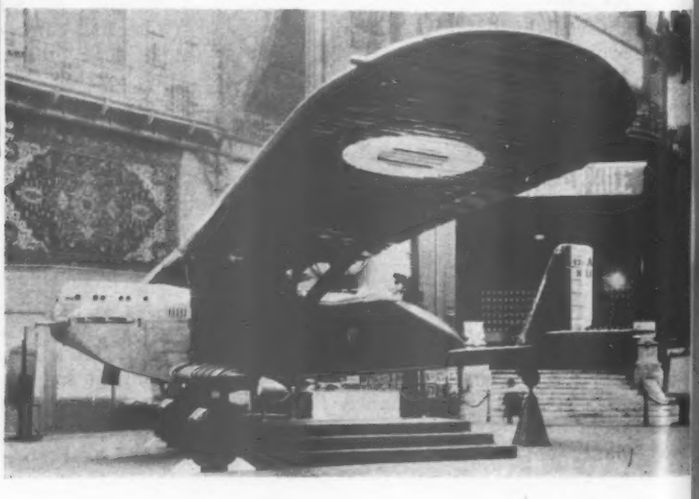
A new variety of fresh air transportation. The Nieuport Delage tri-motor designed for colonial service.



Above: Both ends are open in the radiator tunnel of the Hispano Suiza-powered Mureaux pursuit plane. This is typical of European practice. Below: The latest version of the Breguet "all steel," 270A.



Another tunnel type radiator on the Italian Fiat fighter. The engine is rated at 600 hp. and is rumored to develop about 900.



Airplanes in Paris

The Thirteenth Paris Aeronautical Exposition as it looked to an American

Europe's aircraft industries show their wares

By Edward P. Warner
Editor of AVIATION

IT IS impossible to compare the Salon Aeronautique with an American aircraft show, for they exist in a wholly different atmosphere. The Salon has three essential objects, and the sale of civil airplanes to private owners or to corporations is the least of the three. The first purpose is to show the thrifty and conservative, but drama-loving, people of France what they are getting for the slightly more than two billion francs of their taxes that annually pass through the hands of the Air Ministry. The second is to display military planes to the representatives of a dozen countries that have no important aircraft industries of their own, and that send their officials to Paris to look over the ground for their next orders for air force equipment. There, obviously, was the motive for the participation of three British and four Italian aircraft manufacturers, and American builders of military aircraft ought to give very careful consideration to the possible advantages of seeking a place in the Grand Palais for their own products before the next Salon is too close upon us.

Before looking for novelties in detail as I walked about the Grand Palais, I looked for novelties in general layout. I found two that seemed important,—a tailless Nieuport and the latest idea in autogiros, sponsored by Liore-Olivier and developed under the direct supervision of Captain Lepere, well remembered in America for the time that he spent here during the War and for the planes that were built from his designs at that time.

The tailless monoplane is a return to an old love, as Nieuport built under license the first of all tailless ships, the Dunne, before the War. Not very different in general from other tailless machines of recent vintage, such as the Hill Pterodactyl and the ships built by Lippisch in Germany, it has flaps that serve both as elevators and ailerons, fins and rudders at the wing-tips, and a three-wheeled landing gear somewhat similar in principle to that of the Stout Sky Car. The sweepback is small for a tailless plane, and in fact the trailing edge is almost straight, the wing being sharply tapered in chord.

Something new in 'giros

Of greater immediate importance was the new autogiro, the first reduction to commercial form of De La Cierva's recent research work of which confused rumors have been reaching America. As compared with previous autogiros, —the Pitcairn and Kellett models, for example, the new machine differs in having no fixed wings, no ailerons or elevators, no wires on the rotor, only three rotor blades, a pylon with only two uprights and a couple of wires for lateral support, and a much-reduced "solidity", or ratio of blade area to area of the swept disc. Obviously, the new structure is much simpler than the old. There is a fixed horizontal stabilizer, which is attached to the rudder and turns with it, but elevator and ailerons are replaced by a controlled tilting of the rotor axis. The extreme angle of tilt is some 10 deg. The rotor blades are rectangular and only about 9 in. wide, giving a solidity of less than .05, as against the .10 which has been common practice in the past. The general appearance is very neat; the control mechanism is simple; a closed cabin seats two persons side by side; the weight is 620 lb. empty and 1,080 lb. loaded; and a 75 hp. engine is reported to give a maximum speed of 100 m.p.h.

Turning to the airplanes, so far as the French industry can be said to show any general trend it is towards the all-metal highwing monoplane, strut-braced to a limited degree but with long overhanging wing-tips, with water-cooled engines for almost all military service and air-cooled engines for commercial work. Only half a dozen low-wing monoplanes were on display, and most of them were intended for passenger transport, where the low-wing idea has gained much ground. Wood still plays the leading part in the construction of sport and training machines, and wooden hulls for flying-boats continue in general favor, but metal construction, even to metal wing covering, is absolutely standard in recent military types and it has been making rapid headway in air transport,—aided by the tendency towards the elimination of external wing

The uncowled wing engines of the Wibault high-speed transport are mounted directly in the line of the wing chord.

bracing on transport planes. Of the five examples of that class on view at the Salon only one, the Bleriot 111, had any wing struts at all.

The Bleriot 111 was the only plane in the show, other than the amphibions, that had a retractable landing gear. The wheels swing outward into pockets in the wings, somewhat as in a Lockheed Orion. The pilot sits behind the cabin.

Good vision the rule

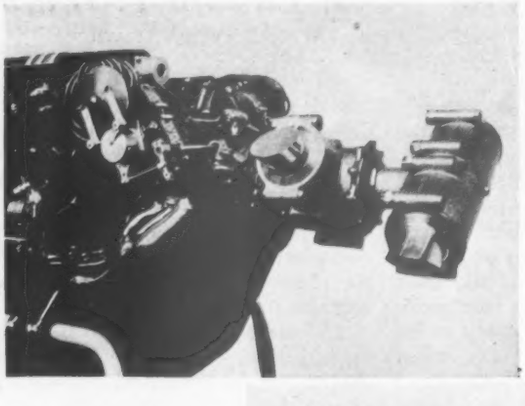
The shifting of the pilot into a position where his forward vision is rather poor is an exception to the general rule among modern French airplanes. Designers have, as a rule, been preoccupied with fields of vision and fields of fire to a greater extent than in America. Two of the exhibitors at the Salon displayed vision charts (a device of which we ought to make more use over here) demonstrating the rate at which the blind angles had been cut down in the course of the development of their pursuit models over the past few years. Gull wings were a feature of one of the two really modern pursuit machines of French origin at the show, the Mureaux 170, and also of the Polish pursuit model, with which we had a chance to become familiar in America through its participation in the Cleveland races in 1931.

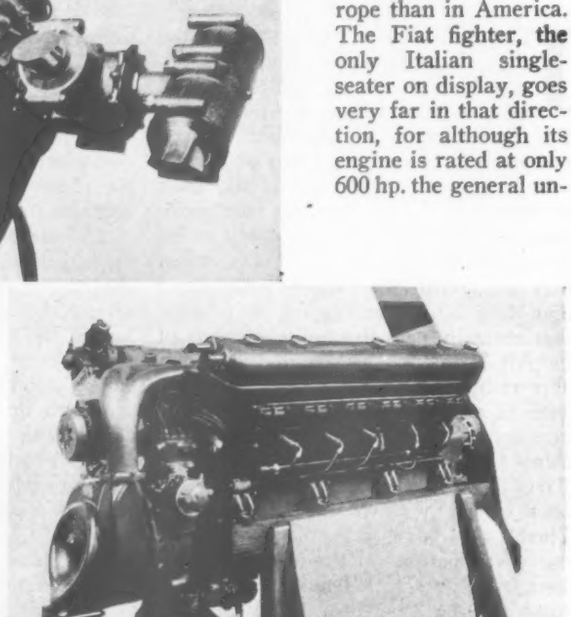
The desire for improved fields of vision (from the rear cockpit) and of fire is also responsible, of course, for the extraordinary arrangement in the Breguet 270 (observation) and Breguet 410 (twin-engined three-seater fighter), of the first of which the first examples appeared some three years ago and which is now in production as one of the three standard observation types of the French Air Force. The top of the fuselage is bent down sharply, immediately behind the rear cockpit, and the sides are brought together so that the fuselage, for the last 8 ft. of its length, is reduced to a steel girder some 16 in.x10 in. in cross-section. The tail surfaces are attached to the fuselage girder with no external bracing.

Three-seat fighters

The mention just made of the Breguet multiplace fighter introduces a type unknown in America, but recognized as of marked importance in France. The two-seater fighter with pursuit load factors and performance is rare in Europe, but its place is taken by the three or four-place twin-engined ship, not very different in general concept from our long-distance Army observation planes such as the Douglas 0-35 and General 0-27, but with a pair of movable guns directed forward and another pair aft.

Freedom from drafts, or at least the reduction of the force of the windstream to a point where it will be possible to stand up against it, has obviously been giving European designers a great deal of concern. In England, the Bristol Company has gone to the length of providing the rear gunner with a totally-enclosed turret, mostly of glass and familiarly known as "the greenhouse." The Breguet multiseater fighter also has provision for complete enclosure, somewhat better faired into the fuselage structure. In several other cases, notably the Breguet 270 (observation) and the Potez 49 (light bomber), the gunner is protected from the slipstream by an almost vertical wind-shield 15 in. or more in height.





Above: The 24-cylinder 2,800-hp. Fiat is two engines placed end to end, with the power from the rear one taken off at the rear end and brought forward through a shaft running between the cylinder blocks and through the inside of the hollow propeller shaft carried by the gear drive of the front engine. Right: On the 800 hp. Lorraine, as on most other water-cooled engines, the supercharger was conspicuous.

No one in Europe, however, has gone the length of totally enclosing the pilot in a pursuit or observation plane. The only hint of that sort at the Salon was found in a model of a new Polish pursuit ship, the P.XXIV, which is to have an air-cooled engine with N.A.C.A. cowling, gull wings, total enclosure of the pilot, guns mounted in the top of the fuselage just to either side of the pilot's line of vision, and an alleged maximum speed of 250 m.p.h.

Pursuit performance

If the Polish plane makes good on that speed it will probably outpace anything else in Europe. Naturally it is difficult to get reliable performance figures on new military types, but the prevailing hope among those best informed, so far as they will express it, seems to be that the best of the numerous pursuit planes now coming through for a French Government competition will show from 210 to 225 m.p.h. at 13,000 ft. altitude. That will just about equal the figures for the Hawker Fury, present standard of the Royal Air Force, and the Fairey Firefly, passed over in England but adopted by Belgium. The British fighters are both biplanes, a fresh reminder that there is no one royal road to high performance. Many aerodynamic combinations are possible, with seemingly equal results, but there is one inescapable necessity,—colossal power. The power of fighters has been pushed up more rapidly in Europe than in America. The Fiat fighter, the only Italian single-seater on display, goes very far in that direction, for although its engine is rated at only 600 hp. the general understanding is that it actually develops something near 900. The performance claimed confirms the suggestion of unprecedentedly high power, for the machine is a biplane of good but certainly not extraordinary appearance, with 290 sq.ft. of wing area, yet it is supposed to give 224 m.p.h at 10,000 ft.

Giant seaplanes in prospect

Only a segment of structure represented the Latecoere 300, seaplane destined for postal service across the South Atlantic. The machine was too unwieldly to transport to Paris and too large to get into the Grand Palais, (it has 148 ft. span and weighs 50,000 lb.), but it was represented by the skeleton of a tip section of the wing. The spars are simple duralumin boxes, the front spar 23 in. deep and 6 in. wide.

The Latecoere was the first of the new crop of giant seaplanes to be completed, but others are upon the way.

The Air Ministry has issued specifications for aircraft to take over the work now being done by small boats of destroyer type and speed in carrying Aeropostale's mail between West Africa and Brazil. Some twenty designs were submitted, and it is understood that prototype orders have been given for four or five of them. Two, besides the Latecoere, were represented at the show by models. Incidentally, if report runs truly in this matter it is another evidence of the generosity with which the French Government has encouraged the development of new types by private manufacturers under the "prototype policy" of General Cacquot, charged with technical development over the last five years. Even at the relatively low costs for experimental work which prevail in France, prototypes of this magnitude could hardly cost less than $300,000 each.

In fuselages there was little to remark except the continuation in France, and to some extent in Great Britain, of the rule of paying more attention to good aerodynamic form than to the reduction of cross-sectional area. Though no European airplane has as bulbous an appearance as the Gee Bee racer, the Gee Bee would have looked much more at home among a group of French observation and "general-purpose" machines than among its American contemporaries. No doubt many of my readers will recall the shock that American aviation received when Pelletier d'Oisy came to our National Air Races in 1925 and when his Breguet 19, huge and lumbering in appearance beside the American competitors, flew to an easy victory in the observation plane event. I well remember having been intimately associated with some rather perplexing efforts to work out a satisfactorily simple means of stowing an ordinary suitcase in an early model of Vought Corsair, and then having gone to England and discovered that the general-purpose (principally observation) machine which had been put at the disposal of the Prince of Wales for his travels had been able, without any fundamental structural changes, to accommodate two suitcases and a steamer trunk.

Flying boats

Though duralumin floats were in vogue at the Salon, flying-boat hulls continue of wood in most cases. Aside from material of construction, French and American practices in hull design have been converging over the past few years. While we have abandoned the extreme spoon bows and wide sponsons of the war-time boats, the French have been breaking away from their old rule of nearly flat bottoms and profiles bent sharply upward towards the tail.

Perhaps the most interesting of all the flying boats was the Italian entry, the Savoia Marchetti 66. Twin-hulled, it keeps the general appearance of the S.M. 55 with which Balbo's squadron crossed the Atlantic, and which was at one time built on Long Island by the American Aeronautical Corporation, but the new model has three engines instead of two and the hulls have been much changed in detail. The old flat bottoms have given way to a concave V with about 20 deg. deadrise from the keel at the step. The structure is, as in the earlier examples, of wood. With a gross weight of 22,000 lb., a span of 108 ft., and 2,100 hp., the S-66 is designed to carry fourteen passengers for 600 miles and to show a maximum speed of 158 m.p.h., probably the fastest machine of its class in the world at the moment.

On all the control surfaces, but especially upon the rudder and ailerons, French practice runs to exceedingly high aspect ratios. Most of the machines at the Salon had rudders with a height of from 2½ to 3½ times the mean rudder chord, where in American design the average ratio is around 2. Similarly, the aileron span on French monoplanes of recent construction is seldom less than 60 per cent of the semi-span of the wing, and not infrequently the aileron runs the whole length of the wing, from tip to root. In such cases, the aileron chord is sometimes as little as 15 per cent of the wing chord, in accordance with the present tendency to decrease the chord of the flap and increase its angle of throw where a flap gear is used as a variable-lift device.

Radiator installations

On the water-cooled ships interest naturally centers on the location and type of the radiator. As in America, most of the high-speed military planes carry it in the bottom of the fuselage, but not so completely enclosed in the fuselage outline as in the case with us. The commoner practice in Europe, shown both on the Mureaux and Fiat pursuits, is to enclose both the radiator and the shutters in a tunnel built as an excrescence onto the bottom of the fuselage and completely open at both ends. The case of the Fiat is especially striking, as the tunnel starts only about 6 in. behind the propeller and continues back about 2 ft., with the honeycomb placed very near the rear, or outlet, end.

The Dewoitine racer had smooth-surfaced wing radiators, and the same type are being installed in the new Nieuport pursuit, so evidently the French technical officials have not lost hope that they may be made satisfactory for military service. Much more interesting, however, was the quick-detachable leading-edge radiator installed on the Bleriot transport. It is composed of a series of separable elements, each essentially a flat tube about 5 ft. long, 2½ in. wide, and ¼ in. deep. The tubes are of thin brass, and the surface that is to be outermost is slightly corrugated to increase the cooling area. Each tube terminates at either end in a round pipe, bent back a couple of inches from the plane of the tube itself so that it may lie entirely within the wing, and each one slides freely in a pair of grooves formed by metal strips on the wing surface. Problems of expansion are eliminated at a stroke, for the radiator tubes, connected by flexible tubing, can expand and contract freely without affecting the wing. The Bleriot machine had two rows of cooling elements above the leading edge and two below, all forward of the front spar, and running over virtually the entire span of the wing.

Wooden propellers losing ground

Propellers at the Salon were of metal in most cases, though wood has not by any means disappeared. In England wood remains the favorite for most service, principally because of its lighter weight,—which becomes particularly important when, as is almost universal British practice, geared engines are used and the diameter of the propeller on a 500-hp. engine may run to 13 ft. or more. Where metal propellers were mounted on the show machines most of them were a slightly-modified version (to give extra strength in the hub) of the old twisted-slab Reed type, made under Reed license by Levasseur. The adjustable-blade idea is gaining headway, however. The designer who wants a metal propeller has no dearth of designs from which to select, as half a dozen different propeller makers, most of them builders of planes or engines as well, were offering their products at the Grand Palais, in steel, duralumin, and magnesium,—fixed pitch, adjustable pitch, controllable pitch, and automatically variable pitch. The Gnome-Rhone and Bristol companies are both working in magnesium. Levasseur alone showed seven distinct types, made from as many different forms of forgings. None the less, the hub to mount a wooden propeller remains a normal part of a European engine, even in the very highest powers. Wooden propellers were in use, for example, on the 700 hp. Isotta-Fraschini engines on the Savoia-Marchetti flying boat.

Incidentally, a table of propeller production figures which the Levasseur people had on their stand served at once to show the trend towards metal and to give perhaps as good a basis as can be found for an indirect estimate of French airplane production,—no official figures on that point being released. In 1927 Levasseur made 101 metal propellers, in 1930, 1,363, and this year they will run to approximately 1,800.

Note these points well!

Separating the promising wheat from the apparent chaff among the airplane displays before going on to discuss the engines, the features and trends which were of most particular interest, and to which it would be well for the American

industry to pay closest attention, were:

1. The use of very high aspect ratios, both on wings and control surfaces. (Which has particular possibilities on metal-covered transport planes and long-range bombers.)
2. The use of a single metal spar, or of two spars built together into a single box truss.
3. The use of flaps to lower the landing speed and act as a brake.
4. Great emphasis on fields of vision, and the development of definite quantitative means of recording them.
5. The Breguet type of fuselage truss (the same effect is secured by slightly different means in certain Potez machines) to improve vision and field of five to the rear in military planes.
6. Extremely deep fuselages of good streamline form.
7. Elaborate systems of windshielding to protect the rear gunner.
8. The Hawker system of construction, applied to stainless steel tube.
9. Ultra-wide landing-gear tracks on small machines.
10. The Bleriot type of quick-detachable wing radiator.
11. The general use of geared engines.

Some of those features are applicable only to a few types of airplane. Some of them might prove not at all applicable in the United States. But they are all worth looking into with an open mind.

Engines

The engines at the Salon, like the airplanes, contained many details of great interest, and included many complete designs of demonstrated merit. Like the airplanes, however, they left an American visitor with the conviction that his own country stands well to the fore, and quite capable of meeting any competition.

The most persistent trends in European engine design seemed to be: a renewed and growing popularity of water-cooling; a widespread use of geared superchargers, and the habitual power rating of all military engines at a considerable altitude rather than at sea-level; the general use of reduction gears; an emphasis on tremendous powers, stimulated largely by the building of special engines for the Schneider Trophy Races; a disposition toward engines running at very high rotational speed and developing a very high power per unit of piston displacement (this again is at least in part the product of the rules of special competitions); the use on water-cooled engines of great numbers of small carburetors (as many as nine in one case); the introduction of a number of W engines; the coming of new diesels; much-improved finning of air-cooled cylinders; the general use of air starters; a growing popularity for magnesium-alloy parts, both cast and forged.

The largest stock engine shown was the 1,000-ph. Hispano-Suiza W, fitted with nine carburetors and reported as weighing 1,350 lb. Apropos of the persisting affection for wooden propellers, already mentioned, it was interesting to see that giant engine driving a propeller hub of the type familiar a dozen years ago, some 14 in. in diameter and about 14 in. long.

Though the Hispano was the largest of the stock engines, several competition models were designed to give much more power. Renault showed an engine designed for the 1931 Schneider Race, which produces 2,000 hp. at sea-level and had a supercharger casing of 21 in. diameter with two 4-in. pipes leading the charge from the supercharger to the cylinders.

Farman displayed a similar specially supercharged design. Most spectacular of all, of course, was the famous 2,800 hp. Fiat, with two engines placed end to end and the power from the rear one taken off at the rear end and brought forward through a shaft running between the cylinder blocks and through the inside of the hollow propeller shaft carried by the gear drive of the front engine. The two shafts are thus concentric, turning in opposite directions, and carry separate propellers running in tandem in planes about 8 in. apart.

The Deutsch Cup, the most important French speed event of the next year, is limited to planes with engines of not more than 488-cu.in. piston displacement, and so far as designers take that event really seriously it will of course have the same effect that limited-displacement automobile racing has had on racing cars,—to wit, a great increase in engine speed and in the unit power output, but with little or no change in the weight per horsepower. The first of the engines designed specifically for the Deutsch Race was shown by Farman at the Salon, and 500 hp., or more than 1 hp. per cu.in. of piston displacement, was promised. An engine on similar principles, though of a somewhat larger size, was displayed by Delage, famous builder of racing cars.

The 2-to-1 reduction gear of the Delage was paralleled on a number of other engines at the Salon. The general tendency, both in England and in France, is toward reduction at a considerably larger ratio than is common practice in America. Most of the reduction gears are of the offset type, with the propeller shaft set up above the crankshaft, but a few, notably the Bristol, stick to the bevel-gear transmission with the crankshaft and propeller shaft in the same line.

It is impossible to say much about the three oil engines at the Salon, for two of them were shrouded in complete mystery. The third, appearing under the trademark of C.L.M., was the Junkers double-opposed piston design, built in France by Peugeot, developing 500 hp., supercharged for constant power up to 13,000 ft., and running at 1,900 r.p.m. Total weight was 2.25 lb. per hp.

The other oil engines were the Clerget design, built by Hispano, and the new Lorraine. Both being extremely hush, little structural detail was apparent except that each had two valves per cylinder, and that the Hispano-Clerget was built both in nine-cylinder and fourteen-cylinder editions, giving around 350 hp. and 550 hp. respectively, and weighing 2.2 lb. per hp. Separate pumps were used for each cylinder, with a ring throttle controlling the pump stroke in the manner of the Packard; and the Hispano had, for some reason, two pipes running side by side from each pump to its cylinder. These new engines are undergoing extensive testing by the French Air Ministry, but are probably hardly ready for commercial use as yet.

No description of the Salon could be complete without mentioning its extraordinary hold upon French interest, and especially upon the French press. Parisian papers with no special aeronautical interest put the show upon the front page day after day, and *L'Auto*, the great sporting daily, gave it at least three columns every day throughout the two weeks that it lasted. More remarkable still was the publication of special numbers of practically all of the first-class illustrated weeklies,—as though a national aircraft show in America were to be attended by the appearance of aeronautical numbers of the *Saturday Evening Post, Liberty, Collier's, The New Republic,* and the *Times Mid-Weekly Pictorial.*

It is difficult to put the spirit of an occasion on paper, but I must not close without paying tribute to the quality of the management and to the courtesy with which visitors were treated. Quite apart from the exhibits that it contained, the artistic success of the show and its success in attracting favorable public opinion reflected great credit on Henry Potez, president of the French Aeronautical Chamber of Commerce, André Granet, long the chamber's general manager, and on its other officials. As one of those who enjoyed the visit to the Salon the more because of the thoughtfulness and the attention of the show officials and of many of the exhibitors, I can express the hope that there may be many more American spectators at the next Salon than at this one. Even though he might come home fully confirmed in his pride and confidence in the products of his own industry, it would be well worth while for every American manufacturer of aircraft to go to Europe at least once in four or five years and see how other people are meeting problems that have much in common with his own,—and he will be wise indeed if he plans to go at the time of a Salon Aéronautique in the Grand Palais.

Orange lettering and the winged T.A.C. monogram in gold identify Transamerican Airline's mail and passenger ships.

The simplicity of plain block letters establishes the identity of Transcontinental and Western Air's planes.

Wings around the Western Hemisphere is the theme of Pan American's markings.

A white eagle and red initials inscribed in a blue-backed white circle form the striking insignia of American Airways.

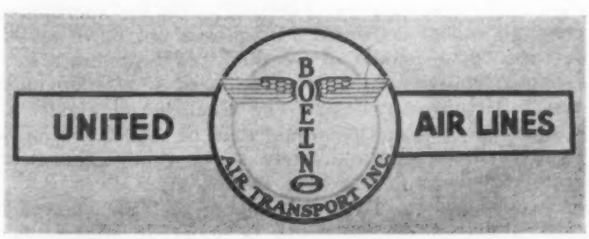
Ludington Airlines spells out its name over an arrow which runs the full length of the fuselage.

The black and gold arrow and winged fuselage motif on Eastern Air Transport liners.

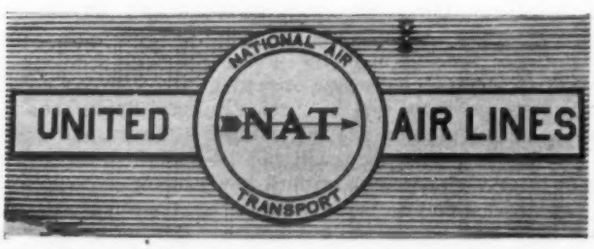
Golden wings on red, white and blue concentric circles mark Northwest Airway's airliners.

Labels

Distinguishing markings on American airlines



The Boeing "bug" as a part of the standard United Air Lines marking familiar to air travellers between Chicago and San Francisco.



Another variation of the United insignia. The arrow-pierced N.A.T. of air mail fame used on the ships of the eastern division.

Backed by two years' experience, a prophet again looks into the future

Estimate of the situation for 1933

By Edward P. Warner
Editor of AVIATION

FOR the third time in as many years, I undertake to prophesy the events of the year to come. It was with immense diffidence that I prepared the first of these personal forecasts. To make private estimates for one's own guidance, or to discuss them with one's friends, is a harmless pursuit, but the man who ventures to put his forecasts into cold type, and so permanently on record, runs the risk of making himself the laughing stock of an industry if he puts them badly.

But now I am growing bold. The forecasts of the last two years have had some measure of success, and in certain respects have turned out to be very close indeed to the truth. It is with some little optimism that I sit down to gaze into the crystal again and to see what it reflects for 1933.

No one would be justified in feeling satisfaction with the accuracy of a past forecast, or confidence of the usefulness of a future one, if it were based upon pure guesswork. There will always be uncertainty in the process of prophecy, for it depends to a large extent upon the workings of human nature and impulse, but uncertainty can be reduced to a minimum if we stick close to the facts for guidance. There is no definite formula for forecasting the airplane market nor the amount of transport operation of a coming year, but there are certain factors which we know to be important, and which can be definitely determined. Fortunately they do not change abruptly, and the trends of the immediate past, with appropriate allowance for new or modifying influences, can be used for interpreting the immediate future. If we proceed methodically, taking into account all of the facts and statistics bearing upon the present position and following the line of recent experience, we may not be perfectly accurate in our predictions, but at least we may be sure that they will not be absolutely at variance with natural law. We can at least count upon saving ourselves from such romantically irradiated claims of the physically or the economically impossible as characterized a good deal of the aeronautical prophesying done in the halcyon days of three or four years ago.

"The man who ventures to put his forecasts into cold type . . . runs the risk of making himself the laughing stock of an industry if he puts them badly."

Transport continues to grow

Again, as last year, transport operations deserve first consideration. In 1932, for the first time in the history of American aviation, the total receipts of the transport lines have exceeded the total sales of aircraft and engines, domestic and export, military and non-military. For 1933 I anticipate that transport revenues will exceed the sale of equipment by almost 30 per cent, and that they will actually exceed the total of all income received by American aeronautical enterprises from all other sources combined,—manufacture, operation of schools, aerial photography, taxi-flying, and all the rest. Already the transport lines have a total revenue one-fifth as large as the total of all the motor buses which operate between American cities. Whether in comparison with other aeronautical activities or with other classes of transport, air transportation has steadily increased its relative importance.

Last year's transport forecast turned out very well indeed. In fact it proved to be almost too good, upon the principle that a 10 per cent error in a highly doubtful figure may indicate good calculation, while a 1 per cent error simply shows good luck. Predictions of 49,100,000 miles of transport flying and of 150,000,000 passenger miles came out within 2 per cent and 6 per cent, respectively, of the true figures for 1932. Only on air express did the forecast go at all astray, for the poundage of express handled has fallen about 24 per cent below the prophecy.

A large part of the mileage is of course effectively fixed by the air mail appropriation. It now appears, if Congress will only leave the budget undisturbed, that that will run a trifle above the level for 1932. At the present time air mail operations are at an average rate, allowing for the normal percentage of trips not flown because of impossible weather, of about 37,600,000 miles a year. Allowing for second sections or additions to service, I anticipate a total of 38,000,000 miles flown with mail in 1933, including both the domestic and the foreign routes.

The mileage without mail is more difficult to predict. For the past year it has been about 14,500,000, but approximately 10 per cent of that mileage came from lines that suspended operation during the year, particularly Century and Century Pacific. For next year I do not anticipate, unless there should be a much more rapid economic recovery than it seems to be safe to count upon, that many new lines will be started. At the end of 1932, the scheduled rate of operations without mail is 11,000,000, with the appropriate deduction for mileage not flown on account of weather, and I predict a total non-mail operation of 11,800,000 miles in 1933. The total in all classes of service would then be 49,800,000 miles, approximately 4 per cent higher than for the year just ending.

The total amount of traffic, however, should show a gain of considerably more than 4 per cent.

During the past two years the average number of passengers carried in each

plane on non-mail routes has considerably exceeded the average on mail routes. With the growing popularity of night flying of passengers, and the constant attempt to adjust mail schedules and conditions of mail-route operation to the convenience of passengers, I expect that situation to come to an end. During the first six months of 1932, the average number of passengers per plane was 2.5 on mail-carrying services, and 3.0 on those without mail. Both domestic and foreign routes were included in calculating these figures. For next year I predict an average of 3.5 passengers per plane on all lines. That will give us 174,000,000 passenger-miles for the year, an increase of 23 per cent over 1932. I do not anticipate any further immediate change in passenger fares from the established level of about 6.2 cents per mile, and the total passenger income of the lines should rise from around $9,000,000 in 1932, to approximately $11,000,000 in the coming year. Taken with an air mail appropriation of $27,000,000 (domestic and foreign combined), as promised by the budget, we have in prospect a gross transport income of a little more than $38,000,000, the little more representing whatever air express may contribute.

Air mail expectations

To prophesy on the amount of air mail that will be handled is perhaps unimportant. Since the Watres Act became law, the amount of money that the operators receive is determined more by the appropriations than by the number of letters sent through the air. There has, of course, been a loss of air mail this year, but it was only an apparent loss, due to the rerouting of certain transcontinental mail so that it was counted once whereas previously it had been counted three times, until the new rates took effect in July. Up to that time, though the figures do not show it, the amount of air mail carried in 1932 was running about 5 per cent ahead of 1931. Since that time the true figure has been off about 20 per cent from the previous year.

For 1933 I expect the mail poundage report to run about 20 per cent below 1932 through the first six months, and about 8 per cent above through the last six, giving an apparent total of 7,000,000 lb., as against 7,500,000 in 1932. Notwithstanding the terrific economic collapse of the last three years, however, and notwithstanding the 60 per cent increase in air mail rates, the amount of mail handled will still stand well above the 1929 level.

Of course the estimate just given is based on the assumption that air mail rates will remain where they are now. The Postmaster General has recommended a decrease in first-class postage rate to the old 2-cent figure, and if Congress agrees to that he will presumably cut the air mail back to the 5-cent rate at the same time. In that event, the total of air mail poundage ought to be around 8,300,000.

"A large part of the air transport mileage is of course effectively fixed by the air mail appropriation."

Express traffic has been left to the last, not only because it is at the present time the least important of air transport sources of revenue but also through a desire to get the comparatively easy jobs out of the way first. The prediction of express traffic is no simple matter. It depends, perhaps more than either passenger or mail business, upon the general swing of the economic tide. It depends also upon the number of specialized express services that are operated, upon the energy and ability with which they are sold, and upon purely psychological factors, which are the most difficult of all to forecast. Undoubtedly a great deal of matter has been sent by air, and will be for the next year or two, for purely emotional reasons or from motives of publicity. Truly economic traffic is always slower to develop on a new service than is the showy and temporary type. As new air mail services always get a deal of business on their first runs from stamp collectors, so new air express services can count on a certain amount of temporary support from shippers who like to be photographed in the act of handing a parcel to the pilot. How long it will take before we pass completely out of that stage, and before air express has settled back into its permanent state of gradual growth and of sole dependence on shipments that really gain enough advantage from going by air to make the added expense permanently worth while, is anybody's guess. Some lines, of course, have been in the business so long that they have emerged from the spectacular stage completely. The present indication is that about 1,350,000 lb. of express will have been flown in America this year. For 1933 I set it at 1,900,000 lb., a gain of 40 per cent. That ought to add about $500,000 to the revenues of the lines.

"It reveals one exceedingly bright spot. For the first time in three years it is possible to feel that the bottom of the trough has been reached, and to look forward to an increase in production for the next year."

The temptation is strong to try to prophesy the rate of growth of air transport beyond 1933, but it cannot be done with any safety. The dependence upon governmental relations is too great. I can only say that I believe that *if* the present methods of regulation and the present handling of the air mail are continued, and *if* we begin to make some headway out of the general depression within the next year, 1935 will be a year of very rapid advance in air passenger business. On those conditions I should expect the next two years to go into shaking down the new equipment that is now being developed and introduced, and into the continued study and introduction of operating economy. I expect very rapid headway during the next two years in overcoming that public inertia and suspicion which still face air transport in some quarters. I believe that it is reasonable to hope that the passenger traffic of 1935 will be more than double that of 1932, and that in that year or the following one the revenue from passengers will come to exceed the revenue from mail.

Aerial services and schools

The position of fixed base operation outside of air transport has been quite shaky during the past year, except in a few areas. I am unable to see very much reason for encouragement in that field. The long-range prospects for aerial photography continue excellent; but the general depreciation of land values makes it abnormally difficult to get any private contracts at present. Aerial advertising is a new and growing field, which has had a special stimulus from the introduction of the autogiro, and it should do better in 1933 than in 1932. Miscellaneous "hop" flying and taxi-flying have fallen off badly, and there is no early prospect of the reversal of the decline.

It is impossible to give figures for the future on these matters, because hardly any figures exist for the past. We do know, however, that the largest single activity of the fixed-base operators is the giving of flying instruction, and on that some prophecy is possible.

The business done by the flying schools has decreased considerably over the depression period, largely because of the gradual dawn of realization that a young man cannot go through a school to the point of getting a private or limited commercial license and immediately thereafter begin to draw $8,000 a year as a first pilot on a transport line. We have begun to take a saner view, though by no means a pessimistic one, on the opportunities for professional pilots. The number of student permits issued has fallen from 18,600 in 1930 to approximately 12,000 in 1932. The drop this year was rather larger than I had foreseen, but I do not expect that the decline for 1933 will be so great. The total number of new permits issued during the year should reach about 10,000. I predict that a little less than one-half the total number will go to people who really show some serious interest in learning to fly, while most of the remainder, judging from past experience, will be issued to individuals who lose interest before doing more than taking two or three trial hops. The total enrollment in all flying schools of all classes in the next year should be about 2,500. Pilots' licenses newly issued ought to come to about that same figure, and allowing for approximately 1,250 licenses that will expire during the year and not be renewed, the total of licenses outstanding at the end of the year should be just under 20,000 as against 18,500 now.

Production prospects

One would like to believe that 1,200 new pilots would call for 1,200 new airplanes, but that would be too simple a presumption. Many of the newcomers learn to fly with the object of finding employment on someone else's airplane, and have no immediate hope of raising the money to buy their own. Many of them will keep up their flying by renting a machine by the hour from the school at which they learned, or by joining a flying club where as many as 30 men may use a single plane jointly. We must follow another track to get at the probable production of the year.

Easiest of all to estimate should be the transport demand. Unfortunately there is no regularity about transport purchases, no constant rate of turnover. One can, however, make a fair prediction of what is likely to be needed in the near future from a study of the distribution of the machines in service by types and by age, and from a reflection upon the amount of technical progress that has been made and the improvements in efficiency and economy that have been introduced since the machines now in service were bought.

Following that line, it appears that about 160 of the 600-odd transport planes now in use have become so uneconomical as definitely to call for replacement. Some of them are already on the reserve list, however, while in other cases five old machines will be replaced by three new ones of higher efficiency. The number of new transport planes to be bought for replacement during the year ought to be about 125. Unless there is a more rapid business recovery than I have dared to anticipate, I cannot foresee the inauguration of many new transport lines, and I will put the number of ships for entirely new operation at no more than 25, making 150 transport planes in all, with an aggregate valuation of some four million dollars. About two-thirds of the new planes are likely to be of high-speed types with cruising speeds of 140 m.p.h. or better, and the remainder, speed sacrificed to economy, will be expected to cruise at between 105 and 120.

The purchase of machines for industrial use is likely to amount to very little in 1933, and that of planes for "aerial service" will again be confined to specialized types for specialized work. There is not much to be hoped for from the industrial market until business shall have made a strong recovery from its present levels. The total sales under the industrial and aerial service headings should be around 80, and they will be divided principally among fast open planes and small cabin types for from four to six passengers.

Planes for private pilots

The private market for 1933 will be a replacement market, and a highly competitive one, appealing for favor of customers who have already done enough flying and own enough airplanes to know exactly what they are looking for. With business where it is today, it is not to be expected that very many brand new customers for planes for pleasure use or for private travel can be located, but there are a number of private owners whose machines have now had three or four years of service and are beginning to show wear, and who in any case would like to get hold of something more modern. I allow for about 400 buyers in the private group, and of that number I believe roughly 65 per cent will take open planes, including about 150 light planes, and the rest cabin types. It must, of course, be remembered that all of these figures apply only to airplanes constructed and sold by the regular industry, and exclude the product of amateur builders.

The light planes call for a special note. In each of the last two years my predictions on light plane production have been exceedingly disappointing to those engaged in that branch of the business, and in each year they have turned out to be quite near the truth. For 1933, for the first time, I am able to be relatively encouraging about light plane prospects. In 1931 the market was fantastically over-estimated, and it was hastily flooded with a number of new designs. In 1932 conditions were abnormal because of the large number of ships from the previous year that were either still unsold or incompletely sold and being thrown on to the market as a used product at ridiculous prices. Practically all of that surplus stock has now been either destroyed or digested, and we can take a fresh stand. The new production of light planes (again excluding the amateurs) during 1932 has been just over 100. For next year I foresee a substantial increase in that number, probably around 50 per cent.

Non-military production so far predicted totals 630 machines, with a gross retail value of $6,200,000. There remain only the non-military exports, which should run to about 40 ships, approximately two-thirds of them cabin planes of mixed sizes. That gives us a total 1933 production of 670 non-military airplanes as against about 600 in 1932.

It may not seem a very pleasing figure, but it reveals one exceedingly bright spot. For the first time in three years it is possible to feel that the bottom of the trough has been reached, and to look forward to an increase in production for the next year. The commercial production of airplanes in 1932 has been approximately 600. For 1933 it certainly ought to exceed that figure, though perhaps not by very much.

Through these past years of doubt and depression, as in the period of uncertainty and experiment that followed the war, the aircraft industry has had to be kept alive and its engineering organization maintained practically by military and naval orders. For 1932 the aggregate of commercial business is only about one-fifth of the total of American airplane and engine production in dollar value, and for next year it seems likely to run very little higher than that. Though it is difficult to give accurate estimates for Army and Navy purchases in terms of calendar years, as their bookkeeping is done for the fiscal year which starts on July 1, it is probable that the total of purchases for the Services during 1932 (including spare parts) has been about $25,000,000. For next year it ought to be around $21,000,000, if Congress can resist the temptation to snip bits off the administration's budget. On the other hand, American factories have been broadening their export markets, and the shipment of military machines to foreign countries should be larger than for 1932. The total of American airplanes and engine production in the coming year ought to run a little above $30,000,000.

The first Wednesday in December is a date for which both the manufacturers of aircraft and the operators of transport lines wait each year with bated breath. Upon that day the President transmits to Congress his recommendations for the expenditures of the Government of the United States during the fiscal year which will begin on the first of the following July. Congress is at liberty to depart from his proposals, but usually does so only in minor details. Generally speaking, we can look at the fat volume that contains the budget, if we know where to look, and get an excellent idea of the amount of money that will be spent on purchasing new airplanes for the Army and Navy, on building airways, on aeronautical research, and on payments to the transport lines carrying air mail during the coming year.

Aviation in the Federal Budget

Next year's plans

FOR the first time in three years it is possible to look upon the sections of the federal budget that deal with the Air Corps and Naval aviation and feel comparatively cheerful. Only *comparatively* cheerful. From the aeronautical point of view they still leave a good deal to be desired. For the first time since depression financing started, however, we can feel that military aviation promises to emerge in a fairly solid state from the general pruning of appropriations. Unfortunately, not even that much can be said for the airways, upon which both commercial and military flying depend.

New planes for the Army and Navy

Specifically, we turn to the sections of the budget that cover the purchase of new military and naval aircraft, and we find that the Army Air Corps is to be allowed to spend $8,257,800 for new planes, engines and equipment. A little farther down in the same paragraph, however, there is a provision allowing the Army to return to the old practice (never abandoned by the Navy) of ordering planes in one fiscal year to be charged to the appropriation of the next. The amount of such advance contracting permitted by the current budget is to be $3,000,000, so the total amount of money that the Army may obligate for airplanes will be $11,257,800, a reduction of only 2 per cent from the amount appropriated for the present year. In addition to that, other sections of the draft of the War Department appropriation bill call for $755,100 for airplanes for the National Guard, and $334,400 for the same purpose for the organized Reserve. *The total for new aircraft for all Army activities is to be $12,367,000. That sum for new aircraft is quite small enough to be disturbing to those concerned with the stability of the aircraft industry. It is $4,000,000 less than last year, or than in any one of the four years preceding that, but at least it represents a reduction of only about 3 per cent from the amount provided for the fiscal year that is now half over. The President explained, in the only mention of aviation which he made in the brief message which accompanied the budget, that the estimates were designed to allow the purchase of 375 new airplanes, and to bring the Air Corps to a total of 1,537 airplanes on hand and on order on June 30, 1934. Still, however, there will be a deficit of more than 100 planes below the number called for by the Army's "Five-Year Program"—a "Five-Year Program" which will by 1934 have been eight years in the making, and will not be completed even then.*

The Navy, with its five-year program already finished a year ago, does relatively better than the Army in the plans for next year. Following on a considerable period when it seemed likely that there might be no money at all for a new naval aircraft for the present fiscal year, Congress finally supplied a contract authorization to spend $5,715,000. For next year that has been stepped up to such an extent that, taking cash appropriation and contract authorization together the budget provides for the buying of $8,900,000 worth of new equipment.

The total amount allowed for new airplanes and power plants for the Army and Navy in all their branches will be $21,267,000, as against $18,534,000 for the present year (always assuming that Congress accepts the budget figures without change). That looks like progress, but there had been no previous year since 1925 in which the total appropriation for new planes went below $26,800,000. As compared with even the least prosperous year prior to the present one, the budget estimates for next year show a decrease of 23 per cent. Though the outlook for the aircraft industry might easily be worse, if the general demand for economy at every point be taken into account, it cannot be said to be particularly bright, nor do the appropriations for new production and for experimental planes in the coming fiscal year promise to be large enough to escape the necessity of further scaling down of the production and engineering organizations that have been so painstakingly built up in the industry over the past six years.

More money for experiment

Again, as for two years past, the budget was very friendly to experiment and development. The Army's allotment for that purpose, including the purchase of experimental planes is increased from $2,822,000 this year to $3,035,000 for next. The new figure is larger than for a number of years past, even through the period of prosperity. The Navy's allowance goes down from $2,210,000 to $2,125,000, but the total for all experimental work stands almost at a record level.

Of less interest to the manufacturing industry, but perhaps of even more to the personnel of the services, are the appropriations for maintenance and operation of aircraft. The Army's appropriations for those purposes are to be slightly increased over this year's figures if the budget estimates should be enacted into law, while the Navy's allowance is to be cut from $13,436,000 to $11,940,000. The Air Corps figures have been set up with the specific object of allowing 200 hours of flying for every qualified pilot. They provide, too, for the employment of 272 Reserve officers on active duty throughout the year, as for a couple of years past. The

final result of the summing up of all items is that the amount estimated for the direct purposes of naval aviation is $24,749,000 as against $22,994,000 this year, while the Air Corps gets $26,818,000 as against $25,439,000. The total allowance for the two services will be increased by 6 per cent, as against a decrease of 20 per cent this year below the previous year's figures. It is with great relief that one sees that the budget officials have realized that such drastic reductions cannot go on indefinitely, in spite of the drive for economy.

Air mail static

Though the manufacturers of airplanes and engines naturally have their attention focussed particularly on the military and naval sections of the budget, they must keep a close watch over the Post Office appropriations as well. The demand for transport planes for replacement during the next year is a very promising one, but it will depend largely upon the stability of the relations between the transport operators and the government. For the operators themselves, of course, the contract air mail figures and those for the Department of Commerce work on airways are all-important.

Here again, the estimates gave relatively little of which to complain. In the face of a 10 per cent cut in the amount to be expended for the railroad transportation of mail, the amount allowed for domestic air mail was increased 3 per cent over the first year, or from $19,460,000 to $20,000,000. With a steadily increasing income to the government from the service, the Post Office deficit on air mail should be smaller than for several years past. The explanatory statement attached to the budget assured the Congress that there is no plan for extending or expanding the present air mail service, and that the proposed increase of $540,000 is merely to keep existing routes going. Unfortunately the House Appropriation Committee promptly knocked off another million dollars, bringing it down to $19,000,000, so the operators face at least one more of those drastic cuts in rates of payment of which there have been so many in the last two years.

Foreign air mail continues, for the coming year as for three years past, at $7,000,000.

Darkening the airways

So far, so good. Or at least *comparatively* well. It is on turning to the Department of Commerce that we really begin to get bad news. *For four years, the Airways Division have been engaged in building a system of lighted and safeguarded airways which was a source of justifiable pride to American aviation, and of envy to the rest of the world. This year, for the first time, the process of building has been stopped. The airway system has become static. Next year, under the present estimates, and unless Congress does something about it, will be far worse. We shall actually go backward. Current estimates provide for switching off the lights on 1,500 miles of airway, or almost 10 per cent of the total. The explanatory statement submitted with the President's message euphemistically puts it that these airways will be "changed to provide only for day flying." What that really means is that their distinctive quality as airways is to be destroyed. If we had only day flying to reckon with, we should hardly have needed the development of our airway system at all.*

In terms of figures, the amount estimated for airway work next year is $6,580,000, a reduction of exactly $1,000,000 from the estimated expenditure of the present year, and of almost exactly $2,000,000 from last year. The fiscal year 1934 (that beginning on July 1, 1933) will show a reduction of 22 per cent below 1932.

Digging further into the figures, it develops that all operating costs, such as fuel, electricity, and teletype service, are to be cut about 5 per cent from the present year, while the total of salaries will have to come down about 8 per cent. The organization in Washington will fortunately be left undisturbed, but there will be extensive cuts in the field, and the total personnel of the Airways Division will be reduced from 2,677 to 2,167. The number of radio electricians, for example, will be cut from 20 to 7, the number of junior radio operators from 267 to 211; and the total number of caretakers and attendants for lights and intermediate fields, from exactly 1,000 to 601. With 400 caretakers laid off, the maintenance of present equipment in a condition which will truly safeguard air navigation will be no simple matter.

Regulation

The allowance for the regulation of aircraft will be continued approximately at the present level. It suffered a very sharp cut this year, almost 20 per cent, but the reduced amount of design, production and operation during the depression has lightened the burden on the Aeronautics Branch, and made it possible for them to carry on without abandoning any activities or seeking to transfer any of them to private agencies. Presumably the work will go forward next year in the same way, with a total of $1,100,600 in hand to cover the cost. The estimated average number of employees in the regulatory work is to be 291, the same as during the present year, including 92 inspectors, of whom fifteen specialize on the airlines and five on schools.

In addition to all the other benefits that the aircraft industry gets from the Department of Commerce appropriations, it receives direct income from the sale of a few airplanes each year for the use of the department's personnel. For next year the amount available for that purpose will be about $65,000, as against $100,000 this year.

Less money for weather

The story of the airways is only partially told in the Commerce section of the budget. To complete it one must turn to the Weather Bureau, which comes under the Department of Agriculture, and look for the allotment for meteorological and aerological work. There again the airways prove to have suffered a serious loss.

The expenditure for collecting weather information and distributing it for aeronautical use has been cut in the last year from $1,576,000 to $1,455,000. Now the proposal is that for next year it shall come down to $1,345,600 — a change that will require laying off about 30 of the 450 meteorologists and observers who have been doing the airway work over the past two years. This is, if anything, even more alarming than the proposed decrease in the appropriation for the airways themselves, and the operators of aircraft can only hope that Congress will find some way of saving enough money elsewhere to permit of restoring it at this point, where it is so badly needed.

For aviation in the Coast Guard there is no specific estimate for next year. Maintenance and operation of planes already in the service can continue under the general appropriation, but there will be no money for new purchases. Last year $160,000 was obligated for new flying equipment.

The friendly eye with which the budget officials have regarded research work in the Army and Navy has extended also to the National Advisory Committee for Aeronautics. The Bureau of the Budget and the House and Senate have shown themselves persistently sympathetic to the Advisory Committee's claims, and well aware of the importance of its work, as an independent organization over the past few years. It is a strange anomaly, however, that the President, on the very heels of a Budget which shows by its liberality the confidence that the committee commands, should send in a message recommending the committee's virtual abolition. The estimate for next year calls for $845,000, an increase of $200 over the anticipated expenditure for the fiscal year 1933. Personnel is scheduled to continue at 312 as at present, about 90 per cent of them being attached to the staff at the committee's laboratories at Langley Field. If the Presidential recommendation for transfer of the committee's work to the Bureau of Standards should go through, however, there is no telling what may happen.

EDITORIALS

AVIATION

EDWARD P. WARNER, *Editor*

Creed for the New Year

WHEN President Hoover faced the problem of drafting a Thanksgiving proclamation for 1932, he met with an issue which may have presented some difficulties by going back a hundred and forty years and re-issuing the first proclamation of the first president. That might not be a bad idea in preparing a new-year message to the aircraft industry.

It would do us all good to look back to 1913, and to remember how slender were the means with which the pioneers had to operate. It will help to rebuild sagging spirits if we look back to 1921, and recall the seemingly insuperable difficulties of the post-war deflation of military activity and the failure of commercial aviation to materialize on schedule. There are men still in the business who have vivid personal recollection of both of those periods. Aircraft manufacture and aircraft operation, such as they then were, came safely and securely through their former tribulations. They will come safely through again.

THERE is no use blinking the fact that these are tough times. The period when we can depend on liberal doses of optimism alone has passed. It would be extremely foolish to try for an artificial cheerfulness which would blind us to everything that goes on about us. It would be even more foolish to neglect the bright patches in the scene, or for any important division of the industry to admit that it is beaten.

So far as air transport is concerned, of course, no question arises. Air transport has accomplished the truly phenomenal feat of making steady progress in defiance of the depression, but other aeronautical activities have not done quite so well, and it is there that the need for perspective and sober judgment in the present situation is strongest.

The brightest spot of all as we look ahead is in the conviction that we have definitely touched bottom. Government appropriations for the purchase of aircraft promise to be larger than last year's, and the pressure of replacement demand on private planes and those owned by aërial services grows higher with each year in which practically no replacements are made. Elsewhere in this issue we have analyzed in detail the demand for 1933 and the editor's reason for anticipatting that it will exceed that of 1932 on almost every count. General business and the stock market end the year, on the whole, at levels not far from those at which they began it. Political tension in the national government is relaxed for at least a year. We cannot say just when the process of rebuilding will definitely start, either in the aircraft industry or elsewhere, nor how rapidly it will go forward, but there is an accumulating body of evidence that the process of destruction has reached an end.

TO REBUILD in the field of aircraft manufacture requires two things: The manufacturer must have a product, and he must sell it.

The first condition of staying in business is that engineering must continue to make progress. No one is going to replace a 1930 airplane with a 1933 airplane that looks just like it. In the past three years there has been spectacular progress in transport design and in military design. There has been notable improvement in detail in some of the smaller commercial airplanes, and a few completely new designs of great interest. On the whole, however, the smaller civil types have shown disconcertingly little change in three years. If any faithful follower of AVIATION who has preserved his copies will turn back to February, 1930, and read our report of the St. Louis Show, he will find that a number of planes displayed there bore an extraordinary resemblance to the present-day models.

THE first condition in creating a replacement demand is to make a change. As a general rule the change represents a clear technical improvement, though in some industries a simple change in style will be made where no technical advances are available. We shall not pick out any single quality that seems to us to call for improvement. The present-day airplane is an admirable product. One cannot put his finger down upon it and say that it needs to be faster,

or more economical, or more reliable, or improved in any other special characteristic. It does, however, definitely need improvement somewhere, and it needs to bear clear external evidence of improvement, for the frequent introduction of change is the first law of continuous production in industry. The 1932 show in Detroit looked altogether too much like that of 1931. The next show, whenever it may be held, ought to show a distinctly new line of products. No one could possibly mistake a 1929 automobile for one of 1932 vintage. It ought to be just as impossible to confuse an airplane of 1931 and one of 1933.

Having met the basic requirement of technical development, it remains to sell the product. Sales effort today is too generally dormant or reduced to casual personal contacts. There will be no satisfactory improvement in the sale of airplanes until the merits of newly-produced types are put before present owners and potential purchasers through every possible medium of publicity. There is still business to be had. There is not as much as there was once, but there is still enough to strike for. If the aircraft industry, including the dealers and the small service operators, will enter the year 1933 with a firm determination that the turn has come, and if they will remember that the world was not created in 1927, and that they and their predecessors in this particular line of trade have known harder times in the past than any that are being experienced now, there will be no doubt of their ability to bring about an improvement in the present state of affairs.

Consider the prior art

LET US begin with a platitude. There is nothing new under the sun. That being said, we can get down to business.

Not long ago the head of a research department of a great industrial organization remarked that two-thirds of all the problems referred to his division for solution could be answered without doing any research anywhere except in the library.

His position was not unique. It happens with ludicrous frequency that the "new" ideas wrung from the sweat of the technician's brow have been tried out and have worked or not, as the case might be, anywhere from two to 25 years ago. Every engineering department could well afford to keep at least one of its members busy studying the history of airplane design. That is a function which is usually relegated to the patent counsel's office, and it is exercised there only for the purpose of proving that somebody else's invention is not genuinely new, and can therefore be used without financial recognition. Technical history is even more usefully employed in connection with one's own ideas, not only to find out whether or not they are new, but also to gain inspiration for new lines of thought and development.

NO QUESTION of sentimental desire to keep alive the memory of the work of the pioneers is involved here. Upon purely practical grounds, as a devise for saving money and increasing the rapidity of new development, the study of technical history is an immensely profitable investment.

Furthermore, while we are on the subject, let us remind ourselves that all the arguments in favor of a study of the prior art apply also to the study of current practice in other parts of the world. Nothing is more extraordinary than the degree to which engineers and their industries are often content to sink into a complacent isolation in groups walled off on national lines. The editor of AVIATION has just returned from a tour of Europe—a very pleasant and a very profitable one. Like previous explorations on the same continent, it revealed that although there are a great many people in the European nations who are deeply interested in American developments, there are others who pass us by with a placid scorn. Their scorn is not reserved for America. They apply it equally to each other. Within the past few weeks we have been told by gentlemen of distinguished positions in the aircraft industry or the air transport operators of no less than three European countries that it was perfectly axiomatic that *their* design or construction of aircraft, or their operation of lines, as the case might be, was so far ahead of everything else of the kind in the world that they had nothing to learn from abroad. They were not talking in the hope of getting favorable publicity in AVIATION. They really believed every word of what they said, but it would have been much easier to feel amused by their superb confidence of their own superiority if we had not had such a clear recollection of having heard exactly the same sort of thing from considerable numbers of Americans.

LET US give but four examples to prove our point, and we will scatter them as widely as possible.

Airplane brakes burst upon the aeronautical world with the shock of complete innovation in 1926. Yet six years earlier there had been built a number of commercial airplanes with excellent brakes, and for some years before that there had been somewhat inferior ones. Then the use of brakes had died out for no apparent reason, but the experience was there waiting to be recaptured, and the development was waiting to be taken up again by anyone who took the trouble to read the record.

In 1925 and thereabouts builders of aircraft were very much concerned over the possibility of using enclosed cockpits, especially on transport machines. There was a great deal of speculation about the possible effects upon the pilot's flying judgment, and widespread conviction that enclosure would be definitely

dangerous. Yet in 1920 the Army Air Corps had had several machines with enclosed cockpits, including one transport type which had been flown by a number of pilots under all sorts of conditions, and at least one enclosed machine had been the subject of extended trial as far back as 1912. When the subject became a lively one again in 1926, some slight attempt was made to draw upon that prior experience, but on the whole it received only the most fleeting attention.

SO MUCH for instances of what could be learned from the prior arts. Now take a look at what one country can learn from another.

The welded steel fuselage came into use in the United States about 1922. By 1925 it was almost universal in American aircraft. Yet the disposition of most European manufacturers, and of practically all European governments except two or three, was to consider that welding was an uncertain and a dangerous process which they could not tolerate. The fact that hundreds of welded fuselages had been built in America and in Holland and operated over a period of years without failure, left engineers and regulatory authorities elsewhere quite untouched.

Now take a case from the other side of the ocean. The oleo gear began to come into use in America in 1925. Within a couple of years thereafter it was generally hailed as the only fit shock-absorbing mechanism, and it was going on to most new American aircraft. Yet the use of oleo struts had been common practice in certain European countries, especially in Great Britain, for four or five years previously. We on this side of the Atlantic either didn't know or care.

There are but four instances, chosen at random from a great number in the past. Unless we learn the lessons that they teach, there will be a great number of others, with a dreadful waste of time and waste of money, yet to come in the future.

Hiram Bingham

THE VOICE of the people, demagogues are fond of repeating, is the voice of God. We are not such unlimited admirers of democracy as to believe that. We know that voters have often made blunders. The voters of Connecticut made one on Nov. 8.

Senator Bingham's successor may be admirably qualified to sit in the United States Senate. He may be an ornament to that body and a credit to the commonwealth, but we do not believe that he can replace Senator Bingham. From the aeronautical point of view, Hiram Bingham's seat cannot be filled.

His services to his state have been many, but for the moment we are interested only in what he has done for aviation. He came to the Senate in 1925 as one of the very few members of Congress who knew aviation at first-hand, both in theory and in practice. He was the lone representative of the Senate upon the Morrow Board, and he was one of the two or three members whose past experience of the subject combined with their natural gifts to make them most active in the work of the Board, and at once most searching and most helpful in the interrogation of witnesses. He turned to unremitting advocacy of measures for governmental stimulation and proper governmental supervision of civil aviation, and it was pre-eminently through his efforts that the Air Commerce Act of 1926 was passed in the Senate and that various perfecting amendments have been accepted in the last few years. Aeronautical interests had been urging the passage of such legislation for at least four years before they got it, and they had made exactly no headway at all. To measure the debt that we owe to Senator Bingham and to the other members of Congress who worked with him to set up the Aeronautics Branch, it is only necessary to think of the chaos that would have resulted if the boom of 1927 had come upon us in a total absence of regulation. It might well have done so, and aviation would have received a black eye from which it would have taken many years to recover, and would have become the victim of a welter of hasty and ill-considered measures pushed through 48 legislatures under the influence of panic. The Department of Commerce has saved us from all that, and it was Hiram Bingham and a handful of associates working largely under his leadership who put the Department of Commerce in a position to do the work.

IN the past five years the Senator from Connecticut has kept constant watch over aeronautical appropriations; he has repeatedly defended the Navy's airship construction program against vicious and demagogic attacks; he has publicised the aeronautical work of the government and of the industry before a hundred audiences; and he led a campaign which resulted in the appointment of a special joint committee of Congress to clear up the aeronautical relations between the Army and Navy and to define the place of aeronautics in the defense of American coasts. That the joint committee was stymied and strangled by official non-co-operation must remain a source of lasting regret, but at least the attention of Congress had been directed to the subject.

We refer only to the Senator's official activities, for it is those that have been terminated, or let us hope that we may say rather merely interrupted, by an electorate ignorant of its own interests. The aeronautical world and the State of Connecticut both need the services of Hiram Bingham—explorer, teacher, scientist, statesman, publicist, airplane pilot, aeronautical enthusiast of the first water whose enthusiasm has always been guided by common sense. We shall miss him badly, and we look forward to the time when his participation in the control of government policy may be resumed.

NEWS OF THE MONTH

Peace prevails

ALL is quiet now in the camps of Aviation Corporation. With the removal of the injunction secured by E. L. Cord to prevent the consideration by the board of directors of a deal to secure the assets of North American Aviation through the issuance of 2,000,000 additional shares of stock, a truce was declared to permit him to reach the scene of action (he was in California at the time). In the meantime the two factions compromised on an arrangement providing for the reduction of the board membership to fifteen, five representing the present management, five the Cord interests and the rest appointed by mutual consent of the contending factions. When the full board finally met in unrestricted session its big problem was to pick its successors. Apparently the plan to acquire North American Aviation has been shelved.

As reconstituted the board of directors of Aviation Corporation numbers seventeen, eight of whom including La Motte T. Cohu and E. L. Cord were among the 35 members of the old board. The offices of its chairman and vice-chairman as well as the executive committee and its five subcommittees have been abolished. Following the first meeting of the new board Mr. Cohu presented his resignation as president of the company, will retain his position on the board. Richard F. Hoyt, who has served as chairman of the board of directors of the Thompson Aeronautical and Curtiss-Wright corporations and on the board and executive committee of Pan American Airways, succeeds him as president of the corporation, while L. D. Seymour, vice-president of National Air Transport from 1926 until last spring, will head up its operating subsidiary, American Airways.

With the cessation of hostilities in Aviation Corporation, the Cord Corporation resumed its program of airline acquisition. Through the purchase of a 45,000 share block of stock its holdings in Transamerican Air Lines were increased to almost 95 per cent. It purchased the Martz New York-Buffalo line outright. The Cord Corporation holdings are to be offered to Aviation Corporation at cost.

Coast-to-coast express

At what were record speeds a few years ago air express is now being flown between New York and Los Angeles by the newly organized Air Express Corporation, headed by Philip H. Philbin, Jr. All-metal Lockheed Orions with Wasp engines supercharged to above 500 hp. leave Floyd Bennett Field, the New York terminal, at 6 p.m. and United Airport at Burbank, near Los Angeles, at 12:45 p.m. nightly on schedules of seventeen hours, forty-five minutes, and seventeen hours respectively, an average speed of 150 m.p.h. Pilots are changed at Wichita on each flight. Only through express shipments are carried, half a ton to each windowless plane, in sealed compartments not opened between terminals. First trip out of New York was made with Clyde Pangborn at the controls on Dec. 19 while Buddy Jones flew the eastbound plane on the first leg of its initial flight. Rates for the transcontinental service parallel those charged by other air express carriers.

Airways and highways

Most recent contribution to the speed of air transport connections with New York City is the 3½-mile viaduct highway across the New Jersey Meadows, opened by the Jersey State Highway Commission on Thanksgiving Day with appropriate ceremonies in which all air transport operators servicing New York area participated. The new highway reduces the running time for airline buses between the Newark Airport and mid-town New York to just under half an hour, a saving of some 25 minutes.

Eastern Air Transport is undertaking to do something about the open spaces on the airway map of the Southeastern states. On Dec. 1, a branch line from its New York-Atlanta trunk route, beginning at Charlotte, N. C., was opened to carry passengers, mail, and express to Camden and Columbia, S. C., and Augusta, Ga., cities not previously connected with any national airway system. Investigating the advisability of a new trunk route between Washington and Atlanta, to tap the transportation market of the valleys between the Appalachian and Blue Ridge Mountain chains, two of the company's airliners toured some 2,000 miles through this region. Charlottesville, Lynchburg and Roanoke, Va., and Knoxville, Tenn., are outstanding points on the projected airway.

For the fifth successive month a unique record of 100 per cent completion has been maintained on the night flights of Transcontinental and Western Air between Los Angeles and Kansas City. The standard of daytime operation has been only slightly lower in this territory which consistently provides favorable flying weather.

A basis for air transportation of federal employees acceptable to the Federal Traffic Board has been arranged. An agreement drawn up by the airlines constituting the Air Transport Section of the Aeronautical Chamber of Commerce at an air traffic conference in Chicago provides for payment by the government at the rate of railroad-plus-Pullman fare. However, no federal employee, of whom 1,000 leave Washington daily on government missions, will be carried at less than 80 per cent of the published air fare.

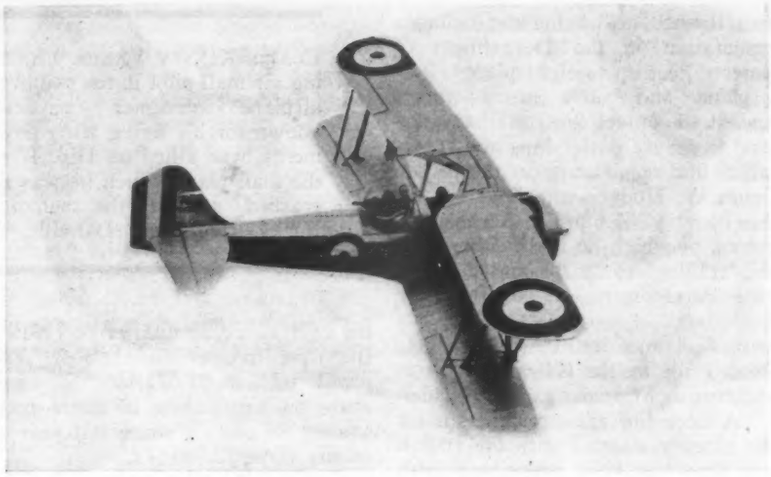
Cuts in payments to air mail contractors at the rate of about $120,000 a month have been effected by the Post Office Department. Retroactive to Nov. 1 and meaning a reduction of about 6 per cent in operators' revenues, the new basis for payments will save the Department about $1,400,000 during the remainder of the current fiscal year. Features of the new formula are the elimination of the bonus to operators providing the two-way radio now required of all mail planes, and relative increase in compensation for providing passenger space, continuing the Department's policy of encouraging this type of traffic. Variable payments for flying under difficult conditions and for providing certain types of equipment are little changed. One of the chief differences from the old formula is the provision for a more substantial reduction in horse-power payment on single-engined planes (that on tri-motors is also cut somewhat), putting upon open-cockpit single-engined mail planes the brunt of the economy.

Transcontinental records

Twelve hours, 33 minutes out of New York's Floyd Bennett Field Col. Roscoe Turner set his yellow monoplane down near the Pacific shores at Burbank, 2,522 miles west, to set a new east-west transcontinental record. He clipped two hours and twelve minutes from the time made in August, 1930, by Capt. Frank Hawks whose round-trip record be-

Calendar

Jan. 3	Second Annual Winter Aviation Cruise to Florida, U. S. Amateur Air Pilot's Association.
Jan. 4	Aircraft Maintenance, Meeting, Aeronautical Chamber of Commerce, Miami, Florida.
Jan. 5-7	Fifth Annual Miami All American Air Races, Miami, Florida.



A CORSAIR FOR THE R.A.F.

The Wasp-powered Corsair purchased from Chance Vought by the British Air Ministry is also equipped for seaplane use. Of the single float design favored by the U.S. Navy for catapult use, it will be a novelty abroad where twin floats are the rule.

tween the two oceans was his original goal. Delay resulting from a tire blow-out at Columbus on the east bound run prevented his breaking the 40-hour mark set by Captain Hawks in June, 1929, in two non-stop flights of nineteen hours, ten minutes and seventeen hours, 38 minutes plus four hours on the ground. Colonel Turner who is aviation engineer for the Gilmore Oil Company of Los Angeles flew the Wasp-powered Wedell-Williams racer in which he followed James Haizlip across the continent to the record-breaking finish of the Thompson Trophy Race last fall.

Down the length of another continent, flew Amy Johnson to cut ten hours, 28 minutes from the record established by her husband James Mollison last March. In one of the Puss Moth planes apparently essential to African record breaking (it was the fourth England-Capetown record for the type) she covered the 6,700 miles between Lympne and the South African city in four days, six hours, 54 minutes. Beset by a series of mishaps and headwinds, fog and rain along her course down the west coast, Miss Johnson hoped to improve on her own time on a return trip. With no improvement in either luck or weather her flight back to England, completed at Croydon on Dec. 18, failed by three days to equal her own time for the southward trip. None the less, it was a new record for the Capetown to England flight, more than two days better than the previous record of two years standing, and gives Miss Johnson undisputed possession of the African course laurels.

The Department of Commerce, through a recent amendment to the Air Commerce Regulations, in the future will keep an eagle eye on flights by Americans to foreign countries. Finding from an analysis of trans-oceanic flights that failures have been largely due to lack of ability in air navigation, insufficient fuel, inability to fly by instruments, and lack of proper equipment, the Department will seek to correct these faults by a code of minimum requirements. It will also require that aspirants secure permission for landing or flight over the foreign countries included in the itineraries.

Pan-American plans

Longest stride toward trans-oceanic air transportation from this side of the Atlantic is being taken by Pan-American Airways which for two years has been flying the longest non-stop over-water commercial route in the world, the Kingston-Barranquilla jump on its route between the Colombian city and Miami. It has let contracts for complete engineering on two types of flying boats which are capable of scheduled trans-oceanic operation with mail loads. One is being developed by the Sikorsky Aviation Corporation of Bridgeport, the other by the Glenn L. Martin Company of Baltimore. Though specifications were drawn up some fifteen months ago, no definite plans for construction have been announced. That the planes will be high-wing monoplanes having a range of 2,400 miles in the face of a 30-mile head wind and a safety margin of at least 600 miles were the only details available.

Winter schedules of European airlines include more routes than have ever been flown before during this off season. For the first time the Berlin-Moscow and Berlin-Leningrad services of German Russian Air Transportation Company will continue operation with passengers as well as mail and freight. Planes on the Russian section of the Moscow run, which has a daily schedule, will be equipped with combination landing gear permitting the use of either wheels or skis. Winter operation of the Munich-Venice and Stuttgart-Freiburg services will also be an innovation, as will the special mail and freight services available between Germany and the Balkan countries when there is sufficient demand. This will be an increase of some 10 per cent over the average daily mileage flown last winter.

New service equipment

Among the new planes recently delivered to the Naval Air Station at Anacostia is an amphibion scouting plane by the Grover Loening Aircraft Co. Designated XS2L-1, it is powered with a supercharged Wasp Junior engine, and has an unusual glass enclosure protecting pilot and observer from the elements. The Berliner Joyce contribution is a light observation plane, with Zap-flap installation. A high-wing monoplane intended for horizontal (as opposed to dive) bombing was delivered and demonstrated by Consolidated Aircraft Co. The Consolidated bomber XBY-1 is similar in general appearance to the company's commercial model Fleetster, but has an all-metal wing construction.

The Annual Report of the Chief of the Air Corps, Major Gen. B. D. Foulois, for the fiscal year, 1932, featured the problems of maintaining the strength of the Corps. It points out that the only available method of increase in Air Corps strength, voluntary transfer of officers commissioned in other branches is inadequate, since the Air Corps is now 396 officers under strength. A net gain of eighteen officers during the 1932 fiscal year was only one-tenth the 1930 increase. Amendment to the Air Corps Act to permit the commissioning of graduates from the Air Corps Training Center into the Regular Air Corps instead of into the Reserve would remedy the situation.

Invitations for bids on a supply of 5,600,000 gal. of gasoline have been issued by the Air Corps. Distribution is to be made to the various air stations throughout the country, with Randolph and Kelly Fields in Texas, Langley Field, Va., March Field, Cal., and Selfridge Field, Mich., receiving the bulk of the amount. The contract recently made by United Air Lines for its annual fuel supply amounted to 7,000,000 gallons.

A school of aeronautics devoted to the training of airplane and engine mechanics has been opened by C. S. (Casey) Jones, at 558 Broad Street, Newark, N. J. Field service training is conducted at Newark Airport in the hangar of the Eastern Aeronautical Corporation, which has the airport's service concession. In addition to the regular mechanic's course, a course for master mechanics, involving a year's work, and training for master welders is provided.

Tackling the task of creating an air-minded public, the Newark Museum is presenting a survey of the historical, engineering and industrial aspects of aviation. Two completely assembled planes, a Pilgrim transport and an old 1910 Curtiss "pusher"; a group of aircraft engines including both current industrial and historic types; a wind-tunnel which visitors may operate, demonstrating the principles of heavier than air flight; weather bureau instruments in operation; and the reception of radio beacons and weather reports; construction exhibits of wings, fuselage, etc.; and a rare collection of old balloon and flying prints fill two floors.

The aeronautical industry, as represented by 17 members of the Board of Governors of the Aeronautical Chamber of Commerce, wants no show or exposition during the coming year. At a special meeting on Dec. 12 the Board unanimously expressed the opinion, urged editorially in AVIATION, that the financial state of the industry and limited market in prospect for 1933 indicate rigid economy and the elimination of all possible expense.

Bellancas for Brazil

Following up its purchase of two Pacemakers last October, the Brazilian Government has ordered ten more planes of that type from the Bellanca Aircraft Corporation. They are intended for photographic work in the Army air service and will cost about $225,000. Orders for Bellanca planes were also placed recently by two departments of the United States government. A Wasp-powered Skyrocket, with minor modifications from commercial specifications, is for the Navy. Three Pacemakers with the Wright Whirlwind Series E engines, ordered by the Aeronautics Branch, will bring the Bellanca representation in the Department of Commerce fleet up to eight planes.

Airplane and parts manufacturers who want to contact the Brazilian market and to secure dealerships and representation find opportunity in the person of Orton W. Hoover who is at present in this country. Empreya Aeronautica Ypiranza, of which he is director, is an official trading company and medium for the development of the Brazilian market.

Further advance into the foreign field has been made by the Edward G. Budd Manufacturing Company of Philadelphia. A licensing arrangement similar to that already effected with the Italian Savoia firm has been negotiated with the French airplane manufacturer, Henry Potez, for the use of the Budd "Shotweld" processes, and stainless steel construction. The airplane built by the Budd Company last year and sent to Europe for demonstration purposes, was on the scene during the recent aeronautical exhibition at Paris. Potez is at the moment the most active of French manufacturers, with over 2,000 employees in his plant.

Stainless steel work is also a strong point with New Standard Aircraft, Inc., which recently received an experimental contract from the navy for wing beams on the patrol boat PK-1. New Standard presents another instance of an organization rising from the ashes of receivership under the banner of its former employees, who purchased its assets and reorganized the old firm.

With the transfer of its flying school and service at its Valley Stream Airport to Safair, Inc., Curtiss-Wright Airports Corporation, once operator of 30 bases throughout the country, definitely retired from the operations field. In the future it will concentrate on airplane sales and servicing. At Valley Stream the Mechanics' School will be maintained. Curtiss-Wright flying services at the Boston Municipal Airport have been merged with two other commercial aviation companies operating from the field to form Ames-Skyways, in which it holds a one-third interest.

Fairchild Aviation Corporation and its camera manufacturing, aerial surveying and airplane sales subsidiaries have transferred their executive offices and factories to Woodside, Long Island.

Corporate earnings

Brightest among the financial reports for the third quarter and first nine months of this year is made by United Aircraft and Transport Corporation. Its net income after taxes, depreciation and minority interest amounted to $727,180, equivalent, after deduction of requirements for preferred dividends, to 28 cents a share on 2,084,780 shares of preferred stock; this is an improvement of one cent a share over earnings for the corresponding quarter of 1931. For the nine months ended Sept. 30, net profit totaled $1,671,486, 56 cents a share on outstanding common stock, as against 89 cents a share last year when profits were $2,390,672.

National Air Transport, a division of United Airways, earned $288,124 during the third quarter of 1932, as against $248,350 in the third quarter last year. Unit earnings during the two quarters were 44 cents and 38 cents, respectively, on 650,000 no par shares outstanding. Net profits for the first nine months of this year were $354,278 after taxes and other charges, about 54 cents a share. Earnings during the same period of 1931 totaled $569,603, or 87 cents a share.

The third quarterly report of Waco Aircraft Company is also in the black, thanks to export markets and an accelerating production. A net profit, after depreciation, taxes and other charges, of $25,307, contrasts with a loss of $17,400 in the third quarter last year. The company's nine months report shows a net loss of $35,906, about a third less than the losses during the same period of 1931.

Reduction of losses was also featured in the report of the Curtiss-Wright Corporation and subsidiaries. For the quarter ended Sept. 30, 1932, the net loss was $408,664, after depreciation, interest and other charges, as compared with a loss of $676,234 in the third quarter of 1931. Comparison of the nine months report is even more striking, with 1932 losses at $376,306, as against $2,139,388 in the corresponding period last year.

Wright Aeronautical Corporation, controlled by Curtiss-Wright, reverses the situation, reporting a net loss of $208,312 for the third quarter this year, instead of profit of $293,736 in the third quarter of 1931. Despite third quarter losses, the Wright company earned $148,278, or 24 cents a share during the nine months ended Sept. 30, 1932. The 1931 report for the first nine months shows a loss of $23,548.

While the net loss of $309,600 reported by the Aviation Corporation for the quarter ended September 30 last does not compare favorably with 1931 figures, it does show a decided improvement over the second quarter of this year, when losses were $1,741,499. For the first nine months of this year, the

CLAIRE KINSEY VANCE, fifth ranking air mail pilot in the country and airplane designer particularly known for his flying wing developments, was killed on Dec. 17 when the mail plane which he was flying crashed against the summit of Rocky Ridge near Danville, Calif.

***Genealogy of* AVIATION**

AVIATION was founded by Lester D. Gardner, the first issue appearing Aug. 1, 1916, as *Aviation and Aeronautical Engineering.* In 1920, the *Aircraft Journal* was absorbed and the title became *Aviation* and *Aircraft Journal* to be simplified into AVIATION in January, 1922. The chief editors have been Ladislas d'Orcy, W. Lawrance Le Page, Earl D. Osborn, R. Sidney Bowen, Jr., and Edward P. Warner.

The present staff consists of Edward P. Warner, editor; Leslie E. Neville, managing editor; S. Paul Johnston, assistant editor; Eleanor Neill, statistical editor, and David J. Leisk, art director.

company reported a net loss of $2,875,000, as against $917,904 lost in the first nine months of 1931. A large percentage of the losses in both the third quarter and the nine months period this year were due to the sale of securities.

Personnel

Comdr. Alger H. Dresel, Commanding Officer of the U.S.S. Akron, has been ordered to duty in connection with fitting out the U.S.S. Macon and to take command when it is commissioned. He has been in command of the Akron since June, 1932, during which period the airship has been filling a rigorous schedule of training officers and men for its sister-ship. Comdr. Frank C. McCord has been ordered to relieve Captain Dresel as commanding officer of the Akron.

Upon the resignation of H. E. Talbot about a month ago, G. N. Armsby was elected to succeed him as chairman of the board of directors.

Capt. Harry E. Shoemaker, who since July, 1930, has been in command of the Rigid Airship Training and Experimental Squadron, and in command of the Naval Air Station at Lakehurst, N. J., has been ordered to Sunnyvale, Cal., to take charge of fitting out the Naval Air Station under construction there, and to command it after its commissioning.

The Sperry Gyroscope Company has announced several executive changes. R. E. Gillmor, formerly vice-president and general manager, has been made president; P. B. Bassett, vice-president in charge of engineering, and Robert B. Lea, vice-president in charge of sales. Thomas A. Morgan, formerly president of the company, is now chairman of the board.

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STATISTICS OF THE MONTH

Supplementing the statistical issue of AVIATION, *March, 1932. Page numbers refer to that issue*

AIR MAIL

(Page 106)

Air Mail Operations

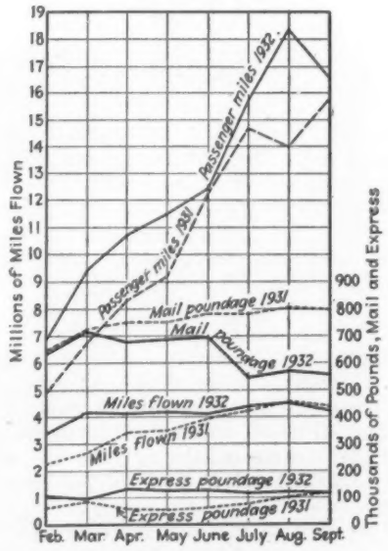
Third quarter, 1932

Mileage scheduled	9,211,350
Mileage flown	9,118,939
Pounds of mail dispatched	1,669,668
Amount paid to contractors	$5,273,625.66

INDICATED in the report of July operations (page 451, November, 1932), the effect of increases in air mail postage on poundage is plainly demonstrated by figures for the third quarter, compiled from the Post Office Department's monthly reports and graphically presented below. Amount of mail dispatched was almost 20 per cent below the level of the previous quarter of this year, in direct contrast to increases of 2 and 4 per cent for the same periods of 1930 and 1931. Postage increases share with a change in accounting systems the responsibility for a drop of 30 per cent from the amount of mail dispatched during the third quarter of last year. Transcontinental letters previously counted, as they changed airways, as often as three times, are now counted only once in the final poundage totals. Scheduled mileage and mileage actually flown have increased 9 and 10 per cent, respectively, over figures for the same period of 1931. A record of 99.0 per cent of all scheduled mileage flown during the quarter was remarkable.

Notable exceptions to the downward course of mail traffic among the individual contract routes are two transcontinental lines and the connecting link between the national capital and a third nationwide system. Poundage increased 16 per cent on route 34, between New York and Los Angeles and more than a third on the Atlanta-Los Angeles (route 33) and Washington-Cleveland (route 11) runs, as compared with the third quarter last year.

Reduction of variation in compensation among the various operators continues. The highest average per-mile compensations of 73 and 70 cents were paid on the New York-Los Angeles and Chicago-San Francisco routes, respectively runner-up and leader in total distance flown during the quarter. At the other end of the scale, only five routes were below the half-dollar line. Last year top price during the quarter, 86 cents, also went to the Chicago-San Francisco route with Atlanta-Los Angeles a close second. Fifty-eight cents per mile flown was the average compensation for all routes during the 1932 period, about 10 cents below the figure for the third quarter of 1931.



Scheduled transport operations by months, 1931 and 1932.

AIR TRANSPORT

(Page 102)

Scheduled Air Transport Operations

First nine months of 1932

Miles scheduled	39,335,580
Miles flown	36,695,629
Passengers carried	390,600
Passenger-miles flown	107,804,869
Air express carred (lb.)	1,019,973
Gasoline consumed (gal.)	15,350,726
Oil consumed (gal.)	457,318

IMPROVEMENT over previous records is the rule of air transport operations. Points on the monthly curves, which with the exception of that for mail are based on figures from the Aeronautical Chamber of Commerce, are almost invariably above 1931 levels. Increases over last year's totals for the nine-month period are more conspicuous. Outstanding among them is the 49 per cent rise in air express poundage to past the million mark. A passenger-mileage figure one-fifth larger than that for the 1931 period in the face of an increase of only 12 per cent in passengers carried indicates the increasing length of the average flight. In this connection, a study made by the Department of Commerce puts the average length of trip at 275 miles for the third quarter of this year. Scheduled transport planes during the first nine months of 1932 flew 17 per cent further than the 31,000,000 miles covered in the same period of 1931.

PRODUCTION AND LICENSING

(Page 118)

Licenses Valid

Dec. 3, 1932

Pilot licenses	18,530
Student permits	8,321
Mechanic licenses	8,381
Licensed aircraft	7,344
Identified aircraft	3,192
Total approved	10,536

SIDE SLIPS

By Robert R. Osborn

WE SEE in the columns of our favorite magazine that Ludington Air Lines are now issuing commuter's tickets, which will enable regular line travelers to obtain eight rides for the price of seven.

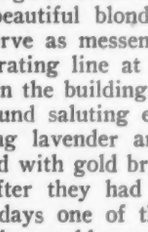
Note for the Department of Commerce: Some strength data and regulations on straps for "straphangers" will be needed very shortly.

It was interesting to note that Kill Devil Hill had drifted 400 ft. since the Wright brothers made their first flight from it 29 years ago, and that Army engineers had to plant a variety of field grasses to anchor the hill well enough that a monument could be placed on top of it. Modern airplanes are not greatly different from that first Wright machine, and apparently the Wright brothers set the precedent in regard to modern airports also. Never having seen Kill Devil Hill we don't know if that field was equipped with the standard airport high-tension power line, but it seems to have had all of the rest of the accepted characteristics.

We were deeply pained to read in the papers that the executives of ice companies in the Western States had decided that from now on ice shall be delivered in large black satchels and that the ice-men shall be "ice attendants," and are to be outfitted with white uniforms and brass buttons. This is just one more indication that the day of the "he-man" is rapidly passing. We have gradually come to accept star-spangled movie ushers with painted and powdered faces who lisp to us that there are seats in the last aisle of the balcony; spick-and-span gas station attendants who buzz around the car like flies, each with his specialty of air-in-tires, windshield wiped, water in radiator, oil checked; white-clad bakers who deliver bread wrapped in cellophane and already sliced; butchers who have eliminated sawdust from the floor, and waiters who deliver pats of butter without thumbprints thereon. And now the ice-man is to become only another memory!

If we are to become a nation of sissies it is pleasant to realize that aviation will be one of the last footholds of hard-boiled citizens. Our mechanics are still grease-covered from head to foot, leave off the cover for the gas tank, after spilling the last gallon on the cowling with considerable of a flourish, scare all visiting pilots with repeated warnings about the difficulty of getting over the trees at the end of the field, and pass out weather and flying information well-punctuated with resounding oaths. Salute the aviation mechanic,—we think he will be the last to wear pink-striped shorts!

Speaking of movie ushers reminds us of one proof we had that they are often not as bad as they are painted. At one of the Detroit shows during the "boom," one of the large aviation companies had hired two beautiful blond male movie ushers to serve as messengers between the demonstrating line at the field and the exhibit in the building. They were running around saluting everyone, and were wearing lavender and gray uniforms, loaded with gold braid and brass buttons. After they had been around for several days one of the mechanics out on the line could not resist a comment questioning the ancestry of the usher who happened to be passing. Instantly he was dragged from underneath the ship on which he had been working, and leaned up against the fuselage with the following advice: "Listen Buddy. I'm earning a living at this racket,—the only way I can just now. I don't like this vaudeville make-up any better than you do and you'd better go easy on cracks like that last one. If I hear just



one more from you or anybody else around here I'm going to knock somebody from between their ears."

We'll bet that mechanic is still going meekly to the last row in the balcony when he is told that there are no other seats available.

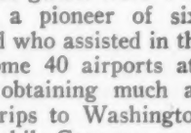
"The accident occurred . . . when, attempting to take off from the soft mud . . . C. resorted to the device of 'stalling his plane off' which consisted in running a short distance, cutting off the power, and then taking off through the use of the controls."—New York *World-Telegram.*

This type of take-off, my dear Watson, is most useful for the purposes of skipping hedges, fences and other landscape ornaments, but is not recommended for general use, even on soft muddy fields.

From Mr. E.C.E. of Pocatello, Idaho, comes a clipping from the local *Tribune:* "Among the guests were . . . A.A.B., of Boise, a pioneer of six years in Alaska and who assisted in the construction of some 40 airports at a cost of $263,000, obtaining much air through personal trips to Washington."

Mostly while Congress was in session, we suppose.

"The Rev. J. C. Brown, the 'Flying Parson' of Oxboro Heath, has solved the problem of how to get in plenty of flying time without being late for dinner. Mr. Brown owns a three-piece open-cockpit plane, which he brings down at a local field, about 10 miles from his home. Then, formerly, he'd drive home in an automobile. But that



was too slow, and today he also owns a tiny 450-lb. ship which he can set down in a field at the rear of his residence."

Clipping from the New York *Evening Post,* by J.H.Y., of New York, who wonders why the parson didn't use one of the pieces of his other ship rather than buying a smaller ship.

Because of some differences between Imperial Airways and the Persian government, the airline to India has to detour a considerable distance. When the expected changes in the Prohibition Amendment are made over here, possibly resulting in local option for the individual states, we wonder if some of our trans-continental airlines are not going to have to do some detouring in order to retain popularity.

The Intrepid Aviator stopped in the office a few minutes ago, and dropped a newspaper clipping on our desk in place of the two cigars he had previously picked up. The clipping showed a picture of a lad outfitted with highly ornamental flying togs, sitting in an ice box, with the description beneath the picture, "J.N.G., an English aviator, who plans a flight into the Arctic, sits for a period each day in a refrigerator in order to accustom himself to sub-zero temperatures."

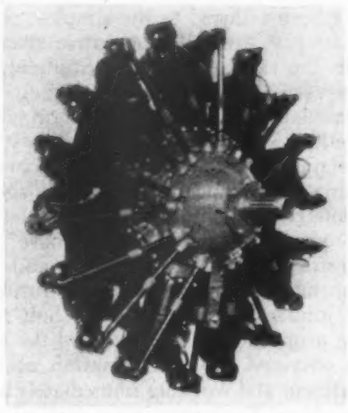
The Intrepid Aviator says that he hopes this clipping will answer some of the unfair criticism of the fact that he spent the entire summer lying around in the sun, as he was planning a flight south this winter and was just getting himself acclimated.

FLYING EQUIPMENT

Two special-purpose designs by Northrop

MORE encouraging signs are in evidence that designers have broken with tradition and are boldly making use of the fruits of recent aerodynamic research, in the almost simultaneous appearance of two new Northrop-designed special-purpose airplanes. The first to appear was built to the specifications of the Ellsworth-Balchen Expedition for Antarctic exploration, and the second, more recently test-flown, to provide a vehicle for long-range, high-altitude research for Texaco in the hands of speed-pilot Hawks.

Both ships bear the unmistakable Northrop imprint, and although varying somewhat in power-plant and seating arrangement, have structural and aerodynamic characteristics in common. Novelty is apparent, both in the relative arrangement of wing and fuselage, and in the lateral control and speed control devices. Tail buffeting at high speed, and tail surface blanketing at stalling speed, characteristics common to many low-wing designs, have been eliminated by generous filleting near the trailing edge. The extent to which this has been carried out by Northrop is shown in the accompanying picture. Further structural and aerodynamic advantage was obtained by raising the fuselage with respect to the wing, so that the structural members of the latter pass under, rather than intersect the under part of the fuselage. By making the fillets an integral part of the shell, an increase in cargo space has been secured.



Pratt & Whitney's T1C Hornet

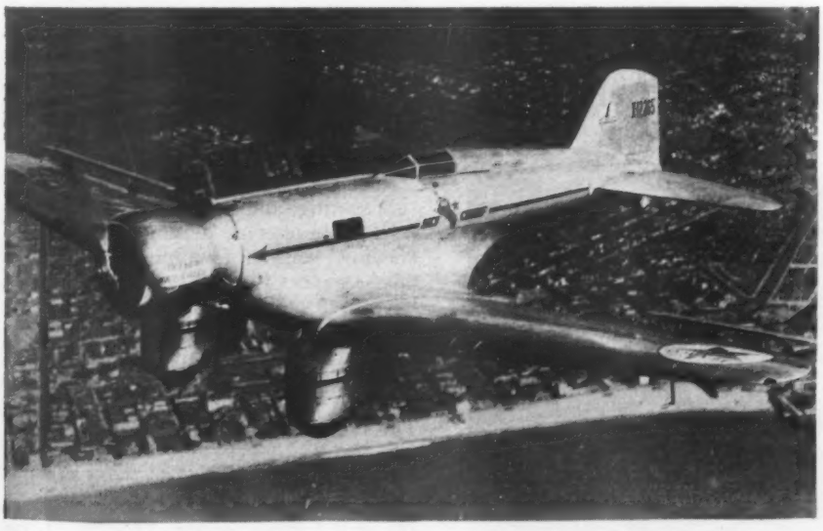
Lateral and stalling speed control has been obtained by a novel combination of ailerons mounted above and independent of the wing structure proper, and a split trailing edge flap fitted to the under-surface of the wing. By thus depressing the bottom surface only of the trailing edge, the total drag of the airplane is increased from 300 to 400 per cent, and, at the same time, the effective lift is increased about 35 per cent. The ailerons, being entirely removed from the zone of influence of the flaps, retain their effectiveness throughout the full range of flying speeds. The use of the flaps permits any desired gliding angle from ratios of 5:1 to 15:1, and allows a reduction in take-off run of about 30 per cent.

The use of new high-strength aluminum and magnesium alloys and a more efficient design of stiffeners for the cover sheets, have made possible an increase of strength-weight ratio of more than 25 per cent. As a direct result, it has been possible to reduce the maximum wing thickness to about 15 per cent of chord, as compared to the 18 to 21 per cent usually found in full-cantilever wings. This fact, coupled with the general cleanness of landing gear and other details, has resulted in a total overall drag for the airplane of under 6 sq.ft. of equivalent flat-plate area, an unusually good figure for a ship with a total area of 363 sq.ft. and a gross weight of 7,100 lb.

Turning now to the differences between the two planes, Hawks' Sky Chief is rigged as a single-seater (inclosed cockpit) with high cargo and gasoline capacity. The normal tankage of 366 gal. has been increased to 616 gal. for the long range, high altitude research program contemplated. The most interesting feature is the installation of one of the new Wright Model GIR-1510, fourteen-cylinder, two-row radial engine, which develops 700 hp. at sea-level. Among the special accessories is a light, two-way radio installation designed by Western Wireless, working on power supplied by an Eclipse engine-driven generator and Exide battery.

The Ellsworth plane is a two-seater, pilot forward and observer aft, under a common enclosure, rigged with dual control. It is powered with a Pratt & Whitney Model FD1 Wasp, driving a Hamilton Standard controllable pitch propeller. An unusual type of ski gear has been designed to be interchangeable with the standard wheels with a total drag less than that of the wheeled gear.

The general specifications which apply to both planes are: wing area, 363 sq.ft.; aileron area, 20.5 sq.ft.; horizontal control area, 57 sq.ft.; vertical control area, 17.5 sq.ft.; weight empty, 3,200-3,400 lb.; disposable load, 3,700-3,900 lb.; gross weight, 7,100 lb.



Frank Hawks' Wright-powered Sky Chief in flight. Note Northrop's latest innovations in filleting and aileron mounting.

Hornet increases power, reduces specific weight

SPECIFIC weight reduction in aircraft engines, once measured in pounds, now progresses slowly but steadily from decimal point to decimal point. Pratt & Whitney's Hornet T1C, now ready for commercial production after a year's service testing, has an announced specific weight of 1.20 lb. per hp. A member of the standard C

Hornet family, it has attained its 700-hp. rating with a bare weight of 840 lb. by refinement in design over preceding generations. The most obvious change is in the arrangement of finning over the cylinder heads. In this respect it follows the pattern of the original single-row and the subsequent fourteen-cylinder two-row Wasp Juniors. A marked increase in the number of individual fins results in greater strength and a considerable increase in cooling area, leading to a reduction in cylinder head operating temperatures.

In addition to the usual Scintilla and Stromberg accessories, the standard equipment includes generator drive, propeller hub attaching parts, single tachometer drive, single auxiliary vacuum pump drive, and an oil pump. A notable feature is the modification of the nose-piece to incorporate the recently developed control mechanism for Hamilton Standard hydro-adjustable propellers. Combination hot-spot and oil temperature regulator, as well as sheet-metal inter-cylinder cooling air deflectors are also fitted. The complete specifications for this engine are included in the table on page 32 of this issue.

A study in simplified structure

WITHIN the past few weeks a trim white sports biplane has appeared on certain eastern fields which looks conventional enough on first glance, but which embodies certain structural features that are sufficiently novel to attract attention. Its designer, A. K. Longren, who is not in any sense a newcomer in the field, has devoted a number of years to the study of sheet metal forming and joining methods which lead toward simplification and straight-line engineering, particularly in fuselage construction. Although Longren Aircraft, Inc., is equipped to produce completed airplanes of the type now being demonstrated, its primary interest lies in the production of bodies and fuselages to fit the requirements of aircraft manufacturers in general. It is claimed that the method of construction is adaptable to military and transport types.

The structural elements of the fuselage have been reduced to the simplest possible terms. Virtually the entire strength is in the skin, the few longitudinal and transverse members being largely for convenience in joining the several panels together. From firewall to tailpost the fuselage is in seven sections, each consisting of two pre-formed dural sheets, geometrically similar, right and left of the plane of symmetry. There are, therefore, only six transverse and two longitudinal joints in the whole fuselage. All joints are the single-row butt type. The properties of the sheets in the shell are obtained by a combination of heat treatment and working immediately after quenching. Each part is pre-formed over solid dies to the exact size and shape required by the finished assembly. Except along the top center line, every body element has curvature in two directions. A great deal of the strength and stiffness of the structure results from contra-flexure. The total weight of the finished fuselage (with engine mount but without seats and auxiliary equipment) is 162 lb. It was static-tested up to a distributed load of 19,300 lb. without any sign of failure.

The only real bulkhead in the whole fuselage is a deep U-shaped ring at the firewall. The structural arrangement for mounting the engine (inverted Glenn Martin 333), is remarkably clean and simple. Two pairs of V-shaped welded steel tube brackets are cantilevered out from the firewall bulkhead on each side of the fuselage to take the supporting lugs of the engine. Rubber insulation is provided.

The cockpit coaming is a pre-formed dural tube designed not only to give a finish to the opening, but to restore the strength of the shell lost by the cut-out. Aside from the internal forming ribs, the only structural members inside the fuselage are in the neighborhood of the cockpit section. Their only function is to distribute the highly-localized loads which occur at the wing and under-carriage fittings to the fuselage shell. Due to the location of the forged dural fittings and the rigging of the wing cellule without stagger, all the main flying and landing loads are concentrated in a vertical plane passing across the fuselage just ahead of the cockpit.

The tail wheel mounting is the most interesting part of the chassis. The wheel is carried in a simple fork, which is an integral part of, and in line with the rudder post. It is thus steerable with the rudder. When the plane is on the ground, the axis of the fork is inclined slightly forward. The effect on ground maneuverability is remarkable, for even a pilot of limited experience (as is the writer) has no difficulty in handling the machine on the field in almost any sort of normal wind and with any reasonable throttle setting. Except for the very shortest of turns, it is unnecessary to touch the brakes—a light pressure on the rudder pedal does the trick.

Except that the fuselage is somewhat elongated and the tail surfaces are therefore at a distance behind the wings somewhat greater than is found in the average machine of this type, there is nothing abnormal in the appearance of the Longren biplane. Clark Y sections are used for both the upper and lower wings. Spars are solid wood and ribs, which are in three parts, are of formed dural sheet. Surfaces are fabric covered. The upper wing is somewhat larger in span than the lower. It is rigged without dihedral, but the lower panels have 4 deg. The gap-chord ratio is slightly higher than average — its mean value beting 1.31. Ailerons of the plain, unslotted type are rigged on the bottom wing only. Offset axes permit a 2:1 differential—30 deg. up and 15 deg. down. Each torque-tube extends inward under the cockpit, making possible a very simple and direct connection to the stick yokes. With this combination of aileron and cellule the machine exhibits excellent lateral control at stalling angles—the controls are firm, and there is no noticeable tendency to fall off on one wing.

The cockpit is laid out for side-by-side seating, and is rigged for dual control. The internal arrangement of first machine lacks a few inches for maximum comfort for two persons, but plans have been made for shifting the seating slightly to eliminate this difficulty. Visibility from the cockpit is good, and a simple, well-thought-out windshield makes it practically free from air blast. The ship may be flown comfortably without goggles.

The general characteristics of the airplane are: span, 28 ft.; total wing area, 177 sq.ft.; gross weight, 1,650 lb.; wing loading, 9.322 lb. per sq.ft.; power loading, 13.75 lb. per hp.

Longren's biplane with simplified dural monocoque fuselage.

THE BUYERS' LOG BOOK

Ignition synchronizer

BREEZE Corporations, Inc., of Newark, N. J., are manufacturing an instrument for synchronizing the ignition systems on double-ignition aircraft engines. The device consists of a small metallic case containing two glow type indicators, to which three insulated cables with clip terminals are attached. Two of the terminals are fastened to the spark plugs on any cylinder, and the third grounded to the cylinder shell. With the engine running at idling speed, the exact firing of the two plugs may be observed from the indicators in the instrument. When both glow at the same instant both magnetos are in synchronization. If, however, one glows before the other, it is necessary to adjust the timing or the breaker points until both fire at exactly the same time.—AVIATION, *January, 1933.*

Paint spray gun

TWO new models of paint spray gun, Type M for large industrial and automotive work, and Type N for fine touch-up and high lighting, are being marketed by the Alexander Milburn Company of Baltimore, Md. These guns can be furnished for syphon or pressure feed, with nozzles for materials ranging from the finest lacquer to emulsified asphalt. The bodies of the guns are of aluminum-alloy, and all passages for air or liquids are straight drilled, making for easy cleaning. The density or volume of the fluid is controllable, as well as the amount of air. A latching device locks the liquid control valve shut for safety while the operator is climbing ladders or scaffolds, and also permits the full air supply to be used for dusting. The Type M weighs approximately 1¼ lb. and the Type N, ½ lb.—AVIATION, *January, 1933.*

Utility tractor

THERE are a variety of jobs around an airport which can be handled by a tractor of the type produced by the J. I. Case Company, and designated as a Case Model CC. This machine is equipped with a four-cylinder valve-in-head engine of 3⅞-in. bore and 5½-in. stroke, running at 1,100 r.p.m. It has three forward speeds ranging from 2.6 to 5.1 m.p.h., and one reverse. It may be equipped with a variety of accessories, including power-driven grass

Milburn Type M spray gun.

cutters, rakes, harrows and snow plows, and is also furnished with the necessary draw bar to permit towing airplanes in and out of hangars, etc.—AVIATION, *January, 1933.*

Electrolytic lubrication

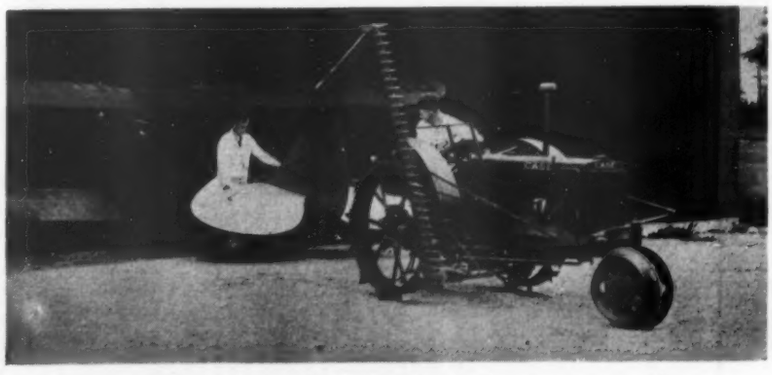
A METHOD of lubrication for all types of automotive and industrial bearings by the use of a new material is being marketed by Lubriplate, Inc., of New York. The material, Lubriplate, is fed to bearings in the ordinary manner, and has the property of depositing electrolytically an infinitely thin film of metallic zinc on the wearing surfaces. The minute electrical potential set up between the working parts of the machinery furnishes the plating current. The film cannot be measured except by very precise laboratory methods, and therefore does not affect clearances in either ball or roller bearings. Lubriplate is available in both fluid and non-fluid form in containers ranging in size from a few ounces up to 500-lb. steel drums. The controllable pitch propeller mechanism in Doolittle's Gee Bee Super-Sportster in which he set a new world landplane high-speed record, was lubricated with this material.—AVIATION, *January, 1933.*

Two-ply stainless steel

COMPOSITE sheet material to be known as Ing-O-Clad stainless steel has recently been announced by the Ingersoll Steel & Disc Company for applications where corrosion resistance, strength and high finish are desired. The new metal is produced by a patented process from a composite ingot which assures a perfect bond between a stainless steel surface and a carbon steel back. It may be deep drawn, stamped, welded, formed and polished. The Allegheny Steel Company of Brackenridge, Pa., has obtained a license to manufacture this new material.—AVIATION, *January, 1933.*

Engine primer

NEW engine primer models are being offered by the Imperial Brass Manufacturing Company of Chicago, Ill., for all types of power plants in single, twin, or three-engined planes. The primer plunger is fitted with double cup washers, and is also provided with a positive needle valve shut-off feature, which eliminates the necessity of an auxiliary shut-off in some cases. Attention has been paid both to utility and appearance. The handles are large enough that they may be operated conveniently with gloves, and the dashplate and exposed fittings are attractively finished in a modernistic manner. A new model gasoline strainer has also been added to the list of Imperial Brass aircraft accessories.—AVIATION, *January, 1933.*



The Case Model CC tractor.

American airplane specifications

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

Manufacturer	Designation	General: A.T.C. number	General: Price at factory	General: Type	General: Number of seats	Power Plant: Make of engine	Power Plant: Total rated hp.	Power Plant: R.p.m. at rated hp.	Power Plant: Fuel capacity (gal.)	Power Plant: Normal range	Power Plant: Fuel consumption at cruising speed (gal. per hr.)	Power Plant: Diameter of propeller (in.)	Weights: Wing loading (lb. per sq.ft.)	Weights: Power loading (lb. per hp.)	Weights: Weight empty with cooling water if used	Weights: Payload (lb.)	Weights: Gross weight (lb.)	Performance: High speed (m.p.h.)	Performance: Cruising speed (m.p.h.)	Performance: R.p.m. at cruising speed	Performance: Stalling speed (m.p.h.)	Performance: Climb at sea level (ft.p.m.)	Performance: Service ceiling (ft.)	Performance basis
SINGLE ENGINED PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																								
Aeronautical Corp of America	Aeronca Scout	351	1,245	OML	1	Aeronca	28	2,500	8	240	2.0	64	4.9	26.9	420	50	700	75	62	2,200	36	550	.....	Ms
Aeronautical Corp. of America	Aeronca Collegian	*396	1,695	OML	2	Aeronca	36	2,400	8	240	2.5	72	6.2	24.3	470	190	875	80	65	2,150	44	450	12,000	Ms
Aircraft Mechanics, Inc	Flyabout D-1	439	1,465	CML	2	Con	37	2,500	7	160	3.0	58	5.5	26.0	573	170	962	80	70	2,000	28	350	.....	Ms
AmericanEagle-LincolnAircraftCo.	Eaglet	450	1,575	OML	2	Sz	45	1,750	.....	.....	3.0	.....	5.6	20.4	509	170	922	90	75	.....	25	.....	.....	Ms
Bird Aircraft Corp	Bird	419	4,995	OBL	3	Ja	170	2,000	37	.....	.....	.....	8.8	18.68	1,350	540	2,303	132	111	1,900	35	1,200	20,000	Ms
Bird Aircraft Corp	Bird	387	5,870	OBL	3	Wr Ww	165	2,000	45	500	10.0	.....	9.0	14.0	1,425	355	2,250	130	106	.....	35	1,150	18,500	Ms
Bird Aircraft Corp	Bird	239	2,995	OBL	3	K	100	1,900	35	685	6.0	.....	7.5	19.8	1,230	370	1,990	110	90	.....	.....	800	16,000	Ms
Consolidated Aircraft Corp	Fleet 9 (8)	*428	5,185	OBL	2-3	K	125	1,925	39	475	7.8	96	10.1	15.7	1,278	240	1,967	115	95	1,780	55	540	10,400	Ms
Curtiss-Wright Airplane Co	A-14-D	442	10,895	OBL	3	Wr Ww	250	2,000	58	530	14.5	104	11.6	11.5	1,772	544	2,870	155	132	1,750	56	1,000	17,500	Ms
Curtiss-Wright Airplane Co	B-14-B	485	13,500	OBL	3	Wr Ww	330	2,000	66	550	17.5	102	12.4	9.3	2,008	448	3,067	170	145	1,750	57	1,600	20,000	Ms
Curtiss-Wright Airplane Co	16-E	*463	4,600	OBL	3	Wr Ww	175	2,000	33	350	10.5	102	10.4	12.3	1,357	395	2,150	135	115	1,750	48	1,200	17,500	Ms
Curtiss-Wright Airplane Co	16-K	411	4,488	OBL	3	K	125	1,925	33	400	7.5	96	9.5	15.6	1,176	383	1,950	115	96	.....	54	850	12,500	Ms
Fairchild Aviation Corp	22-C-7	408	2,675	OML	2	Rover	75	1,975	21	320	5.0	84	8.2	18.6	870	218	1,400	105	80	1,850	42	650	12,000	Ms
Fairchild Aviation Corp	22-C-7-A	*438	2,775	OML	2	Cir	95	2,100	21	340	6.0	88	8.8	15.8	940	260	1,500	114	94	1,900	42	750	13,600	Ms
Fairchild Aviation Corp	22-C-7-B	483	3,450	OML	2	Men	125	.....	.....	430	.....	.....	9.3	12.8	1,010	.....	1,600	125	106	.....	44	1,050	20,000	Ms
Fairchild Aviation Corp	24-C-8	475	3,360	CML	2	Cir	95	.....	24	350	.....	.....	9.4	16.8	1,030	.....	1,600	114	94	.....	48	700	12,000	Ms
General Western Aero Corp	Meteor P-2S	482	.....	OML	2	K	100	1,810	32	420	8.0	91	10.7	17.5	1,137	228	1,750	130	105	1,700	40	1,200	.....	Ms
General Western Aero Corp	Meteor P-2	488	.....	OML	2	K	100	.....	.....	.....	.....	.....	.....	16.5	1,069	.....	1,650	.....	.....	.....	.....	.....	.....	Ms
Granville Bros. Aircraft, Inc	Gee Bee Model E	398	5,230	OML	1	War	110	1,850	38	550	7.0	84	14.0	.....	912	50	1,400	155	128	1,750	55	1,400	20,000	Ms
Granville Bros. Aircraft, Inc	Gee Bee Model D	404	4,980	OML	1	Men	125	2,175	38	550	7.0	84	14.0	.....	922	50	1,400	159	130	1,900	55	1,500	21,000	Ms
Great Lakes Aircraft Corp	2-T-1A	228	2,985	OBL	2	Cir	90	2,100	26	370	6.3	78	8.43	17.53	1,016	223	1,580	110	90	1,825	45	550	13,000	Ms
Great Lakes Aircraft Corp	2-T-1E	354	3,185	OBL	2	En	95	2,100	26	370	6.3	78	8.43	16.63	1,016	215	1,580	110	90	1,825	45	550	13,000	Ms
Heath Aircraft Co	LNB-4	456	1,074	OML	1	Heath	25	2,800	9	250	2.4	57	5.16	28.0	450	.....	700	71	60	2,450	40	300	9,000	Ms
Heath Aircraft Co	LNA-40	487	1,224	OML	1	Con	37	2,550	9	250	2.7	60	5.16	18.9	459	.....	700	80	70	2,300	40	450	12,000	Ms
Heath Aircraft Co	CNA-40	495	1,224	OML	1	Con	37	2,550	7	180	2.7	60	6.3	18.2	454	.....	675	85	70	2,300	44	420	11,000	Ms
Kinner Airplane & Motor Corp	Kinner 100-K	490	2,490	OML	2	K	100	1,810	24	360	6.0	90	8.16	16.5	1,090	223	1,650	103	90	1,750	46	800	14,000	Ms
E. M. Laird Airplane Co	Whirlwind LC-B	353	10,850	OBL	3	Wr Ww	300	.....	76	550	.....	.....	10.3	10.1	1,930	390	3,020	150	120	.....	45	1,600	22,000	Ms
E. M. Laird Airplane Co	Speedwing	377	14,250	OBL	3	Pwj	300	.....	78	600	.....	.....	15.3	10.3	1,922	390	3,010	190	150	.....	58	1,600	22,000	Ms
Monocoupe Corp	90	*306	3,375	CML	2	Lam	90	2,375	28	500	5.7	81	11.5	16.9	902	262	1,519	115	100	2,000	52	850	18,000	Ms
Monocoupe Corp	110	327	4,485	CML	2	War-7	125	2,250	28	400	7.5	84	12.3	13.0	1,000	244	1,620	133	112	1,850	55	1,200	22,000	Ms
Monocoupe Corp	90-J	355	3,900	CML	2	War, Jr	90	2,025	28	500	5.7	81	11.4	16.8	902	240	1,511	115	100	1,850	52	850	18,000	Ms
Monocoupe Corp	125	359	4,350	CML	2	K	125	2,050	28	400	8.0	86	12.0	12.7	1,007	199	1,590	133	112	1,800	55	1,200	22,000	Ms
Monocoupe Corp	70-V	492	2,395	CML	2	Velie	65	1,900	29	500	5.0	84	11.4	23.3	948	210	1,515	105	90	1,750	52	650	14,000	Ms
Nicholas-Beasley Airplane Co	NB-8G	452	1,790	OML	2	Ge	80	2,310	21	425	4.2	.....	6.7	15.1	717	493	1,210	110	95	1,950	42	750	18,000	Gt
Pitcairn Aircraft, Inc	PA-8	364	12,500	OBL	1	Wr Ww	300	2,000	80	.....	.....	108	14.4	13.4	2,294	1,020	4,000	.....	.....	.....	.....	.....	.....	Ms
Rearwin Airplanes, Inc	Jr. 4000	469	.....	OML	2	Aero	50	.....	.....	400	2.8	.....	5.6	22.5	525	.....	1,025	100	85	.....	.....	700	.....	Ms
Rearwin Airplanes, Inc	Jr. 3100	481	.....	OML	2	Sz	50	.....	.....	.....	.....	.....	.....	.....	605	.....	1,043	.....	.....	.....	.....	.....	.....	Ms
Swallow Airplane Co	HC	399	.....	OBL	3	Con	165	2,000	40	400	9.0	.....	9.1	13.3	1,358	400	2,200	130	110	1,800	42	1,000	18,000	Ms
Swallow Airplane Co	TPW	253	.....	OBL	2	War	110	1,850	28	350	7.5	.....	5.8	15.5	1,201	170	1,739	100	85	1,650	42	800	10,500	Ms
Taylor Aircraft Co	Cub E-2	455	1,325	OML	2	Con	37	2,550	9	200	2.5	64	5.4	25.0	525	170	925	78	65	2,200	.....	500	10,000	Ms
United-Boeing Airplane Co	Boeing 100	133	20,000	OBL	1	Pww	450	1,800	97	525	20.0	.....	11.8	5.9	1,882	60	2,750	165	140	1,600	55	.....	.....	Ms
United-Stearman Aircraft Co	4-CM-1	325	12,500	OBL	1	Wr Ww	300	2,000	83	636	15.0	108	13.25	13.56	2,563	770	4,067	143	115	1,750	55	950	12,000	Ms
United-Stearman Aircraft Co	4-D	305	12,500	OBL	3	Pwj	300	2,000	106	815	15.0	.....	12.38	12.67	2,297	622	3,800	143	115	1,700	55	1,000	15,000	Ms
United-Stearman Aircraft Co	6-D	402	.....	OBL	2	Pwj	300	2,000	65	490	15.0	108	10.34	9.38	1,925	265	2,814	137	113	1,700	55	1,250	18,100	Gt
United-Stearman Aircraft Co	6-H	458	.....	OBL	2	K	210	1,900	66	700	10.4	108	10.10	13.00	1,893	230	2,727	120	100	1,750	49	880	14,650	Ms
United-Stearman Aircraft Co	6-L	459	.....	OBL	2	Ly	215	2,000	63	650	10.6	108	10.10	12.80	1,952	235	2,749	120	100	1,750	52	820	12,575	Ms
Viking Flying Boat Co	Kittyhawk B-8	*392	4,250	OBL	3	K	125	1,900	35	425	7.5	98	8.37	15.60	1,164	383	1,950	106	90	1,700	38	1,000	16,000	Ms
Waco Aircraft Co	QCF	*416	4,985	OBL	3	Con	165	2,000	40	.....	.....	.....	9.1	13.31	1,288	478	2,200	124	108	1,850	42	1,050	16,000	Ms
Waco Aircraft Co	KBA	460	3,585	O-CBL	2	K	100	1,900	40	500	6.0	.....	8.21	19.85	1,259	341	1,985	101	86	1,750	40	425	10,500	Ms
Waco Aircraft Co	RBA	466	4,195	O-CBL	2	War	110	1,850	40	450	7.0	.....	8.21	18.05	1,250	350	1,985	105	91	1,710	40	500	12,800	Ms
Waco Aircraft Co	PBA	464	4,285	O-CBL	2	Ja	170	2,250	40	400	10.0	.....	9.32	13.23	.....	441	2,250	119	101	2,000	42	850	14,500	Ms
Waco Aircraft Co	UBF	473	5,025	O-CBL	3	Con	210	2,000	40	375	12.0	.....	9.52	10.95	.....	484	2,300	132	116	1,850	42	1,500	16,500	Ms
Waco Aircraft Co	UBA	479	4,895	O-CBL	2	Con	210	2,000	40	375	12.0	.....	9.52	10.95	.....	459	2,300	132	116	1,850	42	1,500	16,500	Ms
Waco Aircraft Co	PBF	491	4,415	O-CBL	3	Ja	170	2,250	40	400	10.0	.....	9.52	13.53	.....	516	2,300	119	101	2,000	42	850	14,500	Ms
SINGLE ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																								
Bellanca Aircraft Corp	Pacemaker	*328	15,550	CML	6	Pwj	300	2,000	112	850	16.0	108	.....	.....	2,465	933	4,300	150	125	1,800	.....	900	17,000	Ms
Bellanca Aircraft Corp	Pacemaker E	476	.....	CML	6	Wr Ww	420	.....	.....	.....	.....	.....	.....	.....	2,707	1,950	4,657	.....	.....	.....	.....	.....	.....	Ms
Bellanca Aircraft Corp	Skyrocket	*319	17,950	CML	6	Pww	420	2,000	120	750	21.0	110	.....	.....	2,582	1,958	4,600	155	130	1,700	.....	1,250	20,000	Ms
Lockheed Aircraft Corp	Vega	*308	.....	CML	7	Pww	420	2,000	100	700	21.5	108	16.4	10.7	2,595	Var	4,500	178	150	1,700	59	1,345	19,750	Gt
Lockheed Aircraft Corp	Orion	421	.....	CML	7	Pww	450	2,100	125	600	29.0	108	18.7	11.5	3,250	Var	5,200	215	180	1,800	64	1,430	21,600	Ms
Stinson Aircraft Corp	R	457	5,595	CML	4	Ly	215	2,000	56	425	12.4	102	14.15	15.5	2,221	1,100	3,325	130	110	1,800	52	675	14,500	Ms
Stinson Aircraft Corp	R-2	489	5,995	CML	4	Ly	240	2,000	56	400	14.0	102	14.15	13.85	2,227	554	3,325	133	112	1,800	59	700	13,000	Ms
Stinson Aircraft Corp	R-3	493	6,495	CML	4	Ly	240	2,000	72	550	14.0	102	14.89	14.58	2,290	570	3,500	138	116	1,800	62	600	12,500	Ms

Bellanca Aircraft Corp.	Pacemaker	*328	15,550	CML	6	Pwj	300	2,000	112	850	16.0	108	.....	.....	2,465	933	4,300	150	125	1,800	.....	900	17,000	Ms
Bellanca Aircraft Corp.	Pacemaker E	476	.....	CML	6	Wr Ww	420	.....	.....	.....	.....	.....	.....	.....	2,707	1,950	4,657	.....	.....	.....	.....	.....	.....	Ms
Bellanca Aircraft Corp.	Skyrocket	*312	17,930	CML	6	Pww	420	2,000	120	750	21.0	110	.....	.....	2,582	1,958	4,600	155	130	1,700	.....	1,250	20,000	Ms
Lockheed Aircraft Corp.	Vega	*308	.....	CML	7	Pww	420	2,000	100	700	21.5	108	16.4	10.7	2,595	Var	4,500	178	150	1,700	59	1,345	19,750	Gt
Lockheed Aircraft Corp.	Orion	421	.....	CML	7	Pww	450	2,100	125	600	29.0	108	18.7	11.5	3,250	Var	5,200	215	180	1,800	64	1,430	21,600	Ms
Stinson Aircraft Corp.	R	457	3,595	CML	4	Ly	215	2,000	56	425	12.4	102	14.15	15.5	2,221	1,100	3,325	130	110	1,800	52	675	14,500	Ms
Stinson Aircraft Corp.	R-2	489	5,995	CML	4	Ly	240	2,000	56	400	14.0	102	14.15	13.85	2,227	554	3,325	133	112	1,800	59	700	13,000	Ms
Stinson Aircraft Corp.	R-3	493	6,495	CML	4	Ly	240	2,000	72	550	14.0	102	14.89	14.58	2,290	570	3,500	138	116	1,800	62	600	12,500	Ms
Waco Aircraft Co.	UEC	*467	5,985	CBL	4	Con	210	2,000	50	460	12.0	.....	11.25	12.86	.....	598	2,700	130	116	1,850	49	1,000	14,400	Ms
Waco Aircraft Co.	BEC	472	6,170	CBL	4	Wr Ww	165	2,000	50	500	10.0	.....	11.25	16.36	.....	598	2,700	121	106	1,850	49	700	13,000	Ms

MULTI-ENGINED TRANSPORT PLANES

Curtiss Aeroplane & Motor Co.	Condor	193	.....	CBL	21	2 Cu Cq	1200	2,450	278	510	65.0	.....	11.8	14.9	11,674	3,800	17,900	145	125	2,150	55	870	17,000	Ms
Curtiss-Wright Airplane Co.	Kingbird D-2	348	25,550	CML	8	2 Wr Ww	600	2,000	130	415	36.0	106	15.1	10.2	3,877	1,230	6,115	142	120	1,700	63	1,000	18,000	Ms
Curtiss-Wright Airplane Co.	Kingbird D-3	440	32,500	CML	8	2 Wr Ww	660	2,000	160	585	34.0	108	15.6	10.0	4,466	Var	6,600	140	122	1,750	63	1,120	17,600	Gt
Ford Motor Co.	5-AT-D	409	.....	CML	16	3 Pww	1260	2,000	277	550	60.0	120	16.8	11.1	8,140	3,610	14,000	150	120	1,700	65	975	17,500	Ms
Stinson Aircraft Corp.	Model U	484	25,900	CML	11	3 Ly	720	2,000	140	400	40.0	99	16.17	12.92	6,055	2,145	9,300	140	119	1,800	58	825	13,000	Ms

AMPHIBIONS AND FLYING BOATS

Amphibions, Inc.	Privateer	370	5,800	OMA	2	War	110	1,850	30	280	8.0	97	10.5	19.0	.....	210	2,100	95	75	1,850	41	550	.....	Ms
Consolidated Aircraft Corp.	Commodore	258	.....	CMF	25	2 Pwh	1150	1,950	650	1,000	60.0	.....	15.8	15.3	10,410	5,300	17,600	128	104	1,700	.....	600	10,000	Ms
C. W.-Keystone Aircraft Co.	Commuter	219	.....	CBA	4	Wr Ww	300	2,000	70	400	15.0	108	9.5	13.8	2,850	640	4,150	112	87	.....	50	850	12,000	Ms
Douglas Aircraft Co.	Dolphin 1	422	35,000	CMA	8	2 Wr Ww	600	2,000	180	555	36.0	108	13.4	13.7	5,970	1,015	8,200	141	111	1,780	62	820	14,600	Ms
Douglas Aircraft Co.	Dolphin 3	432	.....	CMA	8	2 Pwj	600	2,000	180	555	36.0	108	13.4	13.7	5,970	1,015	8,200	141	111	1,780	62	820	14,600	Ms
United-Boeing Airplane Co.	204	157	10,000	CBF	5	2 Pww	450	1,900	80	350	20.0	.....	10.6	12.2	3,358	913	5,000	133	110	1,625	50	.....	.....	Ms
United-Sikorsky Aviation Corp.	S-38	126	.....	CQA	10	2 Pww	840	2,000	330	.....	44.0	.....	14.3	12.3	6,550	.....	10,430	128	110	1,650	55	750	18,000	Ms
United-Sikorsky Aviation Corp.	S-38	356	.....	CQA	10	2 Pwh	1150	1,950	330	.....	.....	.....	14.3	.....	.....	.....	10,430	.....	.....	.....	.....	.....	.....	Ms
United-Sikorsky Aviation Corp.	S-39	375	.....	CMA	5	Pwj	300	2,000	65	350	17.0	.....	11.4	13.3	2,678	.....	4,000	120	100	1,750	54	750	16,000	Ms
United-Sikorsky Aviation Corp.	S-40	454	.....	CMA	38	4 Pwh	2300	2,000	1,066	900	140.0	.....	18.3	14.8	23,000	Var	34,000	135	112	1,750	64	700	13,000	Ms
United-Sikorsky Aviation Corp.	S-41	418	.....	CMA	13	2 Pwh	1150	2,000	520	.....	60.0	.....	17.5	11.1	8,072	Var	12,800	131	115	1,750	60	875	18,200	Ms
Viking Flying Boat Co.	V-2	361	12,000	OBF	4	Wr Ww	240	2,000	60	400	12.0	.....	8.6	14.4	2,300	582	3,450	105	90	1,750	46	750	14.000	Ms

AUTOGIROS

Kellett Aircraft Corp.	K-2	437	7,885	OL	2	Con	165	2,000	35	250	11.0	106	.....	13.30	551	255	2,200	.....	.....	.....	.....	.....	.....	....
Kellett Aircraft Corp.	K-3 Convertible	471	8,135	O(C)L	2	K	210	1,900	34	250	13.5	106	.....	10.95	670	215	2,300	.....	.....	.....	.....	.....	.....	....
Pitcairn Aircraft, Inc.	PC-A2	410	15,000	OL	3	Wr Ww	300	2,000	52	.....	.....	108	[3]1.90	10.00	2,093	376	3,000	.....	.....	.....	.....	.....	.....	....
Pitcairn Aircraft, Inc.	PC-A3	446	15,000	OL	3	Pwj	300	2,000	52	.....	.....	108	[3]1.92	10.20	2,121	415	3,063	.....	.....	.....	.....	.....	.....	....
Pitcairn Aircraft, Inc.	PAA-1	433	6,750	OL	2	K	125	1,925	27	.....	.....	96	[3]1.63	14.00	1,178	214	1,750	.....	.....	.....	.....	.....	.....	....

A —Amphibion
Acp —Aircraft Prod.
AD —Alclad
Aer —Aerol
Aero —Aeromarine
Aut —Autofan
Aw —Air Wheels
B —Biplane
Bo —Bolted
Box —Box spar
Bx —Bendix
C —Closed
Ca —Cable
Can —Cantilever
Cd —Cord
Cg —Corrugated
Ch —Challenger
Cir —Cirrus
Com —Compression
Con —Continental
Cq —Conqueror
Cs —Coiled Springs
Cu —Curtiss
Cv —Conventional
Cy —Cyclone
D —Duralumin
Do —Douglas
Du —Dual
En —Ensign
Ex —Extra
F —Flying boat
Fab —Fabric
G —Glued
Ge —Genet
Go —Goodyear
Gr —Gruss
Gt —Gov't test
Gy —Gipsy
He —Henderson
His —Hispano
Ht —Heat treated
Hyd —Hydraulic
I —"I" section
In —Internal
Ja —Jacobs
K —Kinner
Kh —Kelsey-Hayes
L —Landplane
Lam —Lambert
Lk —Lockheed
Lmd —Laminated
Ly —Lycoming
M —Monoplane
Me —Metal
Men —Menasco
Mo —Monocoque
Ms —Mfr's statement
Na —Navigation
O —Open
Ol —Oleo
Old —Oildraulic
Op —Optional
Pe —Pedal
Pdd —Packard Diesel
Ply —Plywood
Pn —Pneumatic
Pr —Push Rod
Pwh —P & W Hornet
Pwj —P & W Wasp Jr.
Pww —P & W Wasp
Q —Sesquiplane
R —Rubber
Ret —Retractable
Ro —Routed
Rv —Riveted
S —Steel
Sc —Shock Cord
Scd —Screwed
Sd —Stamped
Sh —Sheet
Sol —Solid
Sp —Spruce
Spl —Split Axle
St —Standard
Str —Straight Axle
Sz —Szekely
T —Tubing
Tred —Treadle
Trs —Truss
W —Wood
War —Warner
Wb —Wire Braced
Wh —Wheel
Wi —Wire
Wl —Welded
Wr —Wright
Ww —New Whirlwind

* Licensed also as float type seaplanes.

Autogiro Notes — [1]130 rotor r.p.m. at cruising. [2]Rotor diameter. [3]Disc loading. [4]Disc Area, 1,590 sq.ft. [5]Disc Area, 1,075 sq.ft.

American airplane specifications (continued)

Including only planes with approved type certificates—AVIATION does not assume responsibility for the figures given

Manufacturer and Designation	A.T.C. Numbers	General			Areas (sq.ft.)						Wings					Landing Gear						Fuselage or Hull			
											Spars		Ribs									Framework			
		Span	Length overall	Height overall	Wing	Aileron	Fin	Rudder	Stabilizer	Elevators	Material	How fabricated	Material	How fabricated	Covering material	Type	Tread (in.)	Wheel type and size	Brakes	Shock unit landing gear and tail	Tail wheel	Material	How fabricated	Covering material	Volume of baggage compartment, (cu.ft.)
SINGLE ENGINED PLANES WITH SEATS FOR FEWER THAN FOUR PERSONS																									
Aeronautical Corp. Aeronca	351, 391	36′ 0″	20′ 0″	7′ 0″	142.2	7.9	5.8	10.0	7.1	6.3	Sp	Sol	Sp	G	Fab	Spl	60	Aw 18x8	No	Ol,Spr	No	ST	Wl	Fab	3.0
Aircraft Mechanics Flyabout	439	37′ 9″	21′ 9″	5′ 8″	155	20.0	6.5	7.4	18.8	13.0	Sp	Sol	Sp	Trs	Fab	Spl	54	Aw 16x7-3	No	No	No	ST	Wl	Fab	0.65
American Eagle-Lincoln "Eaglet"	450	34′ 4″	21′ 7″	8′ 0″	164.4	.....	.....	.....	.....	.....	W	.....	W	.....	Fab	Spl	....	Aw 16x7-3	No	Sc	No	ST	Wl	Fab	.....
Bird Aircraft Corp.	239, 387, 419	34′ 0″	23′ 0″	8′ 0″	266.0	17.2	5.8	7.5	19.9	15.6	W	Sol	W	Trs	Fab	Spl	66	Var	Var	Ol,Spr	No	ST	Wl	Fab	15.0
Consolidated Aircraft Corp. 9 (8)	428	28′ 0″†	22′ 8″	8′ 2″	172.7†	21.7	4.3	12.0	15.2	11.5	Sp	Lmd	D	Rv	Fab	Spl	77	Acp 6. 5x10	Acp	Ol	Yes	ST	Wl	Fab	.....
Curtiss Wright Sportsman	442, 485	31′ 0″	23′ 6″†	9′ 2″	248.0	21.5	5.4	10.4	19.1	11.9	Sp	Sol	Sp	Trs	Fab	Spl	81	8. 5x10	Acp	Hyd	Yes	ST	Wl	Fab	.....
Curtiss-Wright Sport Trainer	411, 463	28′10″	21′ 1″†	8′10″	206	17.6	5.0	7.7	18.5†	12.7	Sp	Sol	Sp	Trs	Fab	Spl	76	Aw 6. 5x10	Acp	Hyd	Yes	ST	Wl	Fab	.....
Fairchild 22	408, 438, 483	32′10″	21′ 8″†	8′ 0″	141	29.0	4.1	6.0†	15.8	10.4	Sp	I	Sp	Trs	Fab	Spl	91	6. 5x10	Acp	Ol	No	ST	Wl	Fab	2.0
Fairchild 24	475	35′ 8″	23′ 8″	7′ 0″	145.4	24.6	4.2	6.0	16.0	13.8	Sp	Lmd	Ply	Trs	Fab	Spl	110	Acp 6. 5x10	Acp	Ol	Yes	ST	Wl	Fab	7.0
General Meteor P-2	482, 488	32′ 0″	24′ 2″	7′10″	146.8	16.2	4.3	6.5	17.0	13.5	Sp	Box	Ply	Trs,G	Fab	Spl	70	Aw 20x9	Go	R,Cd	No	ST	Wl	Fab	1.5
Granville Gee Bee E-D	398, 404	25′ 0″	17′ 3″	8′ 0″	89.7	10.3	4.8	6.0	10.6	8.4	Sp	Sol	Ply	G	Fab	Wb	70	Aw 6. 5x10	Acp	Ol,Spr	....	ST	Wl	Fab	2.0
Great Lakes 2-T	228, 354	26′ 8″	20′ 4″	7′11″	171	16.6	3.5	5.7	13.5	9.5	Sp	I	D	Sd	Fab	Spl	70	Wi 24x4	Bx	Ol	No	ST	Wl	Fab	.....
Heath LN	456, 487	31′ 3″	17′ 3″	6′ 2″	135.5	33.6	4.9	5.2	10.0	8.9	W	Sol	Sp	Trs	Fab	Spl	48	Own 16x4.	Op	Sc,Can	No	ST	Wl	Fab	0.5
Heath CN	495	26′10″	17′ 3″	4′ 6″	107.0	25.0	4.3	5.2	10.0	8.9	W	Sol	Sp	Trs	Fab	Spl	48	Own 16x4	Op	Sc,Can	No	ST	Wl	Fab	0.5
Kinner K	490	39′ 0″	23′ 7″	7′ 0″	181.7	20.3	6.8	7.5	18.5	13.9	Sp	Sol,I	Sp	Trs,G	Fab	Spl	97	Aw 19x9.3	Go	K	Yes	ST	Wl	Fab	3.8
Laird LC-B	353	34′ 0″	23′ 9″	9′ 3″	295	.....	.....	13.0	.....	36.0	Sp	Sol	Ply	G	Fab	Spl	....	Bx 30x5	Bx	Sc	No	DT	.....	Fab	40.0
Laird Speedwing	377	28′ 0″	22′ 7″	9′ 0″	202	.....	.....	13.0	.....	26.0	Sp	Sol	Ply	G	Fab	Spl	....	Bx 30x5	Bx	Sc	No	DT	.....	Fab	38.0
Monocoupe	306 355, 327, 359, 492	32′ 0″	20′10″	6′ 9″	117	15.3	5.1†	5.8†	10.6†	9.2	Sp	I	Sp	G	Fab	Spl	66†	Acp 6. 5x10	Acp	Sc	Op	ST	Wl	Fab	4.5
Nicholas-Beasley NB-8G	452	37′ 6″	20′ 3″	7′ 9″	163.6	19.1	6.1	6.6	15.9	11.3	Sp	Sol	Ply	Cv	Fab	Spl	72	Aw	No	Own	No	Me	Wl	Fab	4.0
Pitcairn PA-8	364	35′ 0″	24′ 9″	10′ 2″	251.5	26.5	6.3	7.9	16.5	16.3	Sp	Box	Ply	Trs	Fab	Spl	96	Bx 32x6	Bx	Ol	....	ST	Wl	Fab	60.0
Rearwin, Jr.	469, 481	36′ 0″	21′ 8″	7′ 6″	179.5	.....	4.4	7.0	14.8	12.2	Sp	.....	.....	.....	Fab	Spl	.....	.....	....	R	No	ST	Wl	Fab	.....
Swallow HC, TPW	253, 399	30′11″	23′ 9″	8′10″	268	28.0	3.6	7.8	14.0	16.5	W	G	W	G	Fab	Str	72	26x4	....	Sc	....	ST	Wl	Fab	.....
Taylor Cub E-2	455	35′ 3″	22′ 3″	6′ 6″	168	16.0	3.0	7.0	18.0	11.0	Sp	Sol	Me	Rv	Fab	Spl	56	.....	No	Sc	No	ST	Wl	Fab	.....
United-Boeing 100	133	30′ 0″	20′ 8″	9′ 7″	228	13.8	1.8	8.2	19.9	13.4	Sp	Box	Sp	G	Fab	Str	75	Bx 30x5	Bx	Ol	No	S,D	Wl, Rv	D,Fab	4.0
United-Stearman 4-C, 4-D	305, 325	38′ 0″	26′11″	10′ 2″	307	23.1	6.8	11.2†	27.2†	16.8†	Sp	Sol	Sp	Trs	Fab	Spl	96	War 950x10	War	Aer	Yes	ST	Wl	Fab	47.0†
United-Stearman 6-D, 6-H, 6-L	402, 458, 459	32′ 0″	23′11″	9′ 9″	269.5	26.5	4.4	9.9	21.4	12.7	Sp	Sol	Sp	Trs	Fab	Spl	85	Bx 30x5	Bx	Ol,Cl	Yes	ST	Wl	Fab	8.0
Viking Kittyhawk B-8	392	28′ 0″	22′ 6″	8′ 8″	233.0	22.3	5.7	6.4	24.0	12.8	Sp	Ro	W	G	Fab	Spl	86	Kh 26x4	Op	Ol	No	ST	Wl	Fab	3.0
Waco Model F	416, 473, 491	29′ 7″	20′ 6″†	8′ 9″	242	.....	.....	.....	.....	.....	Sp	Sol	Ply	G	Fab	Spl	71	Acp6.50x10	Acp	Own	Yes	ST	Wl	Fab	.....
Waco Model A	460, 466, 464, 479	29′ 6″	21′11″†	8′ 8″	242	.....	.....	.....	.....	.....	Sp	Sol	Ply	G	Fab	Spl	71	Acp6.50x10	Acp	Own	Yes	ST	Wl	Fab	.....
SINGLE ENGINED PLANES WITH SEATS FOR MORE THAN THREE PERSONS																									
Bellanca Pacemaker, Skyrocket	319, 328	46′ 4″	27′10″	8′ 4″	273	.....	.....	.....	.....	.....	Sp	Sol	Sp	G	Fab	Spl	90	Bx 32x6	Bx	Old	Yes	ST	Wl	Fab	12.0
Bellanca, Airbus	360, 391	65′ 0″	43′ 3″†	11′ 7″	652	.....	.....	.....	.....	.....	W	Sol	Sp	G	Fab	Int	216	Aw 37x16	Go	Old	Yes	ST	Wl	Fab	28.0
Bird 4 Place	388	34′ 0″	23′ 0″	9′ 0″	266	17.2	6.2	7.5	22.2	17.8	Sp	Sol	Sp	Trs	Fab	Spl	66	Acp 6. 5x10	Acp	Aer	No	ST	Wl	Fab	15.0
Consolidated Fleetster 17-A, 20-A	486, 494	50′ 0″	38′ 8″	12′ 0″†	318.1	43.4	13.5	15.7	29.1	20.0	Sp	Box	Sp	G	Ply	Spl	109	Aw29x13-6	Go	.....	Yes	D	Rv	D	30.0†
Curtiss-Wright 15-D	444	43′ 5″	30′ 5″	9′ 7″	240	25.0	7.8	14.2	37.8	18.1	Sp	Ro	Sp	Trs	Fab	Spl	108	8. 5x10	St	Hyd	Yes	ST	Wl	Fab	7.0
Curtiss-Wright 6-A	436	54′ 5″	31′ 8″	9′ 8″	340	33.6	13.7	14.4	40.0	25.4	Sp	Box	Sp	Trs	Fab	Spl	108	Bx 36x8	Bx	Ol	Yes	ST	Wl	Fab	28.4
Lockheed Vega	308	41′ 0″	27′ 6″	8′ 2″	250	25.0	12.5	10.2	31.5	16.0	Sp	Box	Sp	G	Ply	Spl	96	Bx 32x6	Bx	Ol	Yes	AD	Rv	AD	12.0
Lockheed Orion	421	42′10″	27′ 6″	9′ 0″	275	25.0	11.0	13.0	39.0	23.5	Sp	Box	Sp	G	Ply	Ret	139	Acp 11x12	Acp	Ol	Yes	W	Mo	Ply	20.0
Stinson Model R	457, 489, 493	43′ 2″†	26′ 1″†	8′ 6″†	235	30.6	7.6	13.2	27.0	19.5	Sp	Ro	S	Wl	Fab	Spl	95	Aut8.50x10	Aut	Hyd	Yes	ST	Wl	Fab	12.0
Waco UEC, BEC	467, 472	33′ 0″	24′10″†	8′ 6″	240	.....	.....	.....	.....	.....	Sp	Sol	Ply	G	Fab	Own	83	Acp8.50x10	Acp	Own	Yes	ST	Wl	Fab	.....
MULTI-ENGINED TRANSPORT PLANES																									
Curtiss-Condor	193	91′ 8″	57′ 1″	16′ 6″	1512	241	.....	53.0	.....	47.6	ST	Wl	D	Rv	Fab	Tred	244	Bx 54x12	Yes	Ol	Yes	D	Rv	Ply	.....
Curtiss-Wright Kingbird	348, 440	56′ 6″	34′10″	9′ 8″	422	47.8	16.0	27.0	58.0	30.0	ST	Wl	D	Trs	Fab	Spl	143	29x13.5	Go	Ol	Yes	D	Rv	Fab	.....
Ford 5-AT-D	409	77′10″	50′ 3″	12′ 0″	835	52.0	12.7	24.2	81.7	46.8	D	Rv	.....	.....	AD	Tred	223	Bx 44x10	Own	Aer	Yes	D	Rv	AD	119.0
Stinson Model U	484	66′ 2″	45′ 3″	13′ 6″	575	48.0	10.3	16.6	59.0	36.2	ST	Wl	D	Rv	Fab	Spl	199	Aut12.5x14	Aut	Hyd	Yes	ST	Wl	Fab	70.0
AMPHIBIONS																									
United-Sikorsky S-40	454	114′0″	76′ 0″	23′ 0″	1740	100.0	49.5	57.4	149.0	104.7	D	Trs	D	Trs	Fab	Hyd	205	Kh 58x14	Own	Hyd	Yes	D	Rv	AD	125.0
United-Sikorsky S-41	418	78′ 9″	45′ 2″	15′ 3″	729	60.0	12.6	27.6	60.3	34.2	D	Trs	D	Trs	Fab	Hyd	135	Go	Own	Hyd	Yes	D	Sd	AD	.....
Viking V-2	361	42′ 4″	29′ 4″	10′ 4″	359	42.1	4.0	13.0	52.2	27.3	Sp	Box	Ply	G	Fab	.....	.....	.....	.....	.....	.....	W	G	Ply	3.0

AMPHIBIONS

United-Sikorsky S-40	454	114′ 0″	76′ 0″	23′ 0″	1740	100.0	49.5	57.4	149.0	104.7	D	Trs	D	Trs	Fab	Hyd	205	Kh 58x14	Own	Hyd	Yes	D	Rv	AD	125.0
United-Sikorsky S-41	418	78′ 9″	45′ 2″	15′ 3″	729	60.0	12.6	27.6	60.3	34.2	D	Trs	D	Trs	Fab	Hyd	135	Go	Own	Hyd	Yes	D	Sd	AD	.....
Viking V-2	361	42′ 4″	29′ 4″	10′ 4″	359	42.1	4.0	13.0	32.2	27.3	Sp	Box	Ply	G	Fab	.....	.....	.....	.....	.....	.....	W	G	Ply	3.0

AUTOGIROS

Kellett K-2, K-3	437, 471	41′ 0″[2]	.....	12′ 4″	.....	.....	.....	.....	.....	.....	W	Box	W	.....	Fab	Own	144	Aut	Aut	Ol	Yes	ST	Wl	Fab	5.5
Pitcairn PCA-2, 3	410, 446	45′ 0″[2]	23′ 1″	13′ 4″	66.3[4]	24.0	7.8	7.5	15.9	19.2	Sp	Box	Ply	I	Fab	Wb	159	Acp 8.5x10	Acp	Ol,Sc	No	ST	Wl	Fab	3.3
Pitcairn PAA-1	433	37′ 0″[2]	18′ 7″	11′10″	36.5[5]	15.1	6.7	5.3	9.1	13.0	Sp	Box	Ply	I	Fab	Wb	120	Acp 6.5x10	Acp	Ol,Sc	No	ST	Wl	Fab	1.9

Al —Amphibion	C —Closed	Cu —Curtiss	Ge —Genet	Ja —Jacobs	Mo —Monocoque	Pr —Push Rod	Scd —Screwed	Trs —Truss
Acp —Aircraft Prod.	Ca —Cable	Cv —Conventional	Go —Goodyear	K —Kinner	Ms —Mfr's statement	Pwh —P & Hornet	Sd —Stamped	W —Wood
AD —Alclad	Can —Cantilever	Cy —Cyclone	Gr —Gruss	Kh —Kelsey-Hayes	Na —Navigation	Pwj —P & W Wasp Jr.	Sh —Sheet	War —Warner
Aer —Aerol	Cd —Cord	D —Duralumin	Gt —Gov't test	L —Landplane	O —Open	Pww —P & W Wasp	Sol —Solid	Wb —Wire Braced
Aero —Aeromarine	Cg —Corrugated	Do —Douglas	Gy —Gipsy	Lam —Lambert	Ol —Oleo	Q —Sesquiplane	Sp —Spruce	Wh —Wheel
Aut —Autofan	Ch —Challenger	Du —Dual	He —Henderson	Lk —Lockheed	Old —Oildraulic	R —Rubber	Spl —Split Axle	Wi —Wire
Aw —Air Wheels	Cir —Cirrus	En —Ensign	His —Hispano	Lmd —Laminated	Op —Optional	Ret —Retractable	St —Standard	Wl —Welded
B —Biplane	Com —Compression	Ex —Extra	Ht —Heat treated	Ly —Lycoming	Pe —Pedal	Ro —Routed	Str —Straight Axle	Wr —Wright
Bo —Bolted	Con —Continental	F —Flying boat	Hyd —Hydraulic	M —Monoplane	Pdd —Packard Diesel	Rv —Riveted	Sz —Szekely	Ww —New Whirlwind
Box —Box spar	Cq —Conqueror	Fab —Fabric	I —"I" section	Me —Metal	Ply —Plywood	S —Steel	T —Tubing	
Bx —Bendix	Cs —Coiled Springs	G —Glued	In —Internal	Men —Menasco	Pn —Pneumatic	Sc —Shock Cord	Tred —Treadle	

† Minor differences in these dimensions occur in the several models listed.

Autogiro Notes — [1]130 rotor r.p.m. at cruising. [2]Rotor diameter. [3]Disc loading. [4]Disc Area, 1,590 sq.ft. [5]Disc Area, 1,075 sq.ft.

American engine specifications

AVIATION does not assume responsibility for the figures given

Manufacturer or Agent	Engine	Cooling system	Cylinder arrangement	Number of cylinders	Strokes per cycle	Propeller drive	Rated hp. and r.p.m. at sea level	Maximum hp. and r.p.m. at sea level	Weight dry without hub or starter	Weight per rated hp.	Bore and stroke (in.)	Compression ratio	B.M.E.P.	Displacement (cu.in.)	Frontal area (sq.ft.)	Diameter of mounting ring or distance between bearers (in.)	Height or overall diameter (in.)	Length without starter (in.)	Guaranteed fuel consumption at rated hp. (lb.-hp.-hr.)	Oil consumption (lb.-hp.-hr.)	Valve mechanism	Cylinder construction (see footnote)	Number of intake valves per cylinder	Make spark plugs supplied with engine	Number of exhaust valves per cylinder	Type of ignition	Make ignition	Number of carburetors	Make carburetors	Make of starter	Are exhaust manifolds provided	Shipping weight crated	Department of Commerce license number	Price at factory
Aeromarine Pl. & Motor Co.	Aeromarine AR3	A	Rad	3	4	D	50–2125	55–2350	144	2.5	4 3/16x4	5.0	114	160	....	.....	32 1/4	30	.55	.002	prr	A1, S	1	BG	1	2M	RB	1	Sg	Op	Yes	220	74	$560
Aeronautical Corp. of America	Aeronca E113A	A	Opp	2	4	D	36–2400	38–2520	110	3.0	4 1/4x4	5.1	105	113	....	.....	24	24	.57	.017	prr	A1, S	1	BG	1	1M	RB	1	Z	....	No	160	71	675
Continental Aircraft Engine Co.	A-70-2	A	Rad	7	4	D	165–2000	183–2200	415	2.5	4 5/8x4 5/8	5.4	120	544	6.9	20	42 3/4	32 5/8	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Op	Yes	870	32	2,000
Continental Aircraft Engine Co.	A-40	A	Opp	4	4	D	37–2550	39–2800	136	3.7	3 1/8x3 3/4	5.2	....	115	....	.....	16 9/16	26 3/8	.57	.025	Lh	A1, NI	1	BG	1	1M	RB	1	Sg	....	No	240	72	540
Continental Aircraft Engine Co.	R-670	A	Rad	7	4	D	210–2000	230–2300	425	2.0	5 1/8x4 3/8	5.2	125	668	....	20	42 1/2	32 5/8	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Op	Yes	850	80	2,650
Guiberson Diesel Engine Co.	Aero Diesel	A	Rad	9	4	D	185–1925	.....	509	2.74	4 13/16x6	....	....	982	....	.....	....	46 1/8	34 3/16	.....	.....	prr	A1, S	1	.....	1	.....	.....	0	.....	Ec	No	.....	79	.....
Jacobs Aircraft Engine Co.	LA-1	A	Rad	7	4	D	170–2125	.....	390	2.23	4 1/4x4 3/4	4.8	112	528	....	14 3/4	44	33	.53	.017	prr	A1, S	1	Ch	1	2M	Sc	1	Sg	Op	Yes	660	31	.....
Jacobs Aircraft Engine Co.	L-3	A	Rad	3	4	D	55–2125	.....	170	3.09	4 1/8x4 3/4	4.8	112	190	....	13 1/2	37	29	.55	.015	prr	A1, NI	1	Ch	1	2M	Sc	1	Sg	Op	Yes	325	75	.....
Jacobs Aircraft Engine Co.	LA-2	A	Rad	7	4	D	195–2075	205–2200	395	2.03	4 3/4x4 3/4	5.5	126	589	....	14 3/4	42	37 3/4	.50	.025	prr	A1, S	1	HT	1	2M	Sc	1	Sg	Hd	Yes	660	82	.....
Kinner Airp. & Motor Corp.	R-5	A	Rad	5	4	D	150–1950	166–2375	305	2.03	4 7/16x5 1/4	5.0	125	490	....	14	45 3/4	32 1/16	.55	.010	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Op	Yes	605	77	1,985
Kinner Airp. & Motor Corp.	K-5	A	Rad	5	4	D	100–1810	105–1900	280	2.80	4 1/4x5 1/4	5.0	118	372	....	14	44 5/8	32 1/16	.55	.010	prr	A1, S	1	BG	1	2M	Sc	1	Sg Hy	Op	Yes	580	3	1,080
Kinner Airp. & Motor Corp.	B-5	A	Rad	5	4	D	125–1925	127–1950	295	2.4	4 5/8x5 1/4	5.2	117	441	....	14	45 3/4	32 1/16	.55	.010	prr	A1, S	1	BG	1	2M	Sc	1	Sg Hy	Op	Yes	595	51	1,585
Kinner Airp. & Motor Corp.	C-5	A	Rad	5	4	D	210–1900	245–2200	420	2.0	5 5/8x5 3/4	5.2	122	715	....	19 1/4	50	34 13/16	.55	.015	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Op	Yes	950	62	2,250
Lycoming Mfg. Co.	R-680	A	Rad	9	4	D	215–2000	.....	475	2.21	4 5/8x4 1/2	5.3	123	680	....	19 1/4	43 1/4	32 5/8	.55	.025	prr	A1, S	1	HT	1	Sid	Sc	1	Sg	Ec	Yes	900	42	.....
Lycoming Mfg. Co.	R-680-BA	A	Rad	9	4	D	240–2000	.....	505	2.10	4 5/8x4 1/2	6.5	140	680	....	19 1/4	43 1/4	32 5/8	.50	.015	prr	A1, S	1	HT	1	Sid	Sc	1	Sg	Ec	No	930	81	.....
Glenn L. Martin Motors Co.	4-333-B	A	IL	4	4	D	120–2100	130–2300	269	2.24	4 1/2x5 1/4	5.3	136	333	....	11 3/8	34 1/4	42 3/4	.48	.010	ohc	A1, S	1	Ch	1	RB	Sc	1	Z	Op	No	400	59	1,800
Menasco Motors, Inc.	Pirate B-4	A	IL	4	4	D	95–2000	100–2250	280	2.95	4 1/2x5 1/8	5.5	115	326	2.6	11 1/8	28	47 3/4	.54	.006	prr	A1, NI	1	Ch	1	2M	Sc	1	Sg	Ec	No	430	65	1,560
Menasco Motors, Inc.	Pirate C-4	A	IL	4	4	D	125–2175	135–2500	288	2.3	4 3/4x5 1/8	5.8	125	363	2.6	11 1/8	28	47 3/4	.50	.027	prr	A1, NI	1	BG	1	2M	RB	1	Sg	Ec	No	443	67	1,860
Menasco Motors, Inc.	Buccaneer B-6	A	IL	6	4	D	160–1975	180–2500	365	2.2	4 1/2x5 1/8	5.5	130	489	2.6	11 1/8	28	59 1/4	.54	.006	prr	A1, NI	1	Ch	1	2M	RB	1	Sg	Ec	No	570	68	2,475
Michigan Aero Engine Co.	Rover	A	IL	4	4	D	75–1975	86–2200	228	3.25	4 1/8x5	5.1	112.5	267	....	14	31 7/8	37 1/2	.55	.018	prr	A1, NI	1	AC	1	2M	Sc	1	Sg	....	Yes	370	37	1,200
Milwaukee Parts Corp.	Tank 63	A	V-90	8	4	D	115–1650	135–1850	398	3.46	3 7/8x5	5.2	.....	470	.....	.....	.....	.....	.....	.....	prr	A, C	1	AC	1	2M	Sc	1	Z	Op	Yes	550	63	1,050
Milwaukee Parts Corp.	Tank 73	A	V-90	8	4	D	115–1675	130–1850	397	3.45	4x5	5.2	.....	502	.....	.....	.....	.....	.....	.....	prr	A, C	1	AC	1	2M	Sc	1	Z	Op	Yes	550	73	.....
Monocoupe Corp.	Velie M-5	A	Rad	5	4	D	65–2000	.....	223	2.92	4 1/16x3 3/4	5.4	....	250	....	13 3/4	45	28 29/32	.55	.025	prr	A1, S	1	Ch	1	2M	Sc	1	Sg	Ec	Yes	420	4	1,050
Monocoupe Corp.	R-266	A	Rad	5	4	D	90–2375	.....	214	2.37	4 1/4x3 3/4	5.5	113	266	....	13 3/4	33	30 3/8	.58	.025	prr	A1, NI	1	Ch	1	2M	Sc	1	Sg	Ec	Yes	420	38	1,460
Packard Motor Car Co.	3-A-2500	W	V-60°	12	4	D	800–2000	835–2100	1160	1.45	6 3/8x6 1/2	5.7	125	2539	4.8	18 1/4	41 31/32	69 3/4	.52	.025	ohc	S	2	BG	2	2M	Sc	2	Sg	Ae	No	2150	19	15,625
Packard Motor Car Co.	DR-980	A	Rad	9	4	D	225–1950	.....	510	2.26	4 3/16x6	14	93	982	....	22	45 11/16	36 3/4	.46	.04	prr	S	1	.....	1	com	.....	.....	.....	Ec	No	975	43	4,025
Pratt & Whitney Aircraft Co.	Wasp C-1	A	Rad	9	4	D	420–2000	450–2100	730	1.7	5 3/4x5 3/4	5.2	124	1344	....	23 3/8	51 7/16	42 9/16	.55	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1150	14	7,200
Pratt & Whitney Aircraft Co.	Wasp C-1-G	A	Rad	9	4	G[4]	425–2050	.....	800	1.88	5 3/4x5 3/4	5.2	122	1344	....	23 3/8	51 7/16	42 9/16	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1300	55	8,200
Pratt & Whitney Aircraft Co.	Wasp SC-1	A	Rad	9	4	D	450–2100	.....	730	1.6	5 3/4x5 3/4	5.2	125	1344	....	23 3/8	51 7/16	42 9/16	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1150	58	7,200
Pratt & Whitney Aircraft Co.	Wasp SD-1	A	Rad	9	4	D	500–2200	.....	745	1.49	5 3/4x5 3/4	6.0	133.5	1344	....	23 3/8	51 7/16	42 9/16	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1180	76	.....
Pratt & Whitney Aircraft Co.	Wasp S-1-D-1	A	Rad	9	4	D	525–2200	550–2200	745	1.42	5 3/4x5 3/4	6.0	141	1344	....	23 3/8	51 7/16	42 9/16	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1180	90	.....
Pratt & Whitney Aircraft Co.	Wasp T-1-D-1	A	Rad	9	4	D	500–2100	525–2100	745	1.49	5 3/4x5 3/4	6.0	140	1344	....	23 3/8	51 7/16	42 9/16	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1180	91	.....
Pratt & Whitney Aircraft Co.	Hornet B-1	A	Rad	9	4	D	575–1950	.....	855	1.48	6 1/4x6 3/4	5.0	125	1860	....	23 3/8	56 15/16	44 25/32	.55	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1465	28	7,960
Pratt & Whitney Aircraft Co.	Hornet B-1-G	A	Rad	9	4	G[3]	575–1950	.....	953	1.66	6 1/4x6 3/4	5.0	125	1860	....	23 3/8	56 15/16	50 11/64	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1560	28	8,960
Pratt & Whitney Aircraft Co.	Hornet C	A	Rad	9	4	D	600–2000	.....	840	1.40	6 1/4x6 3/8	6.0	140	1690	....	23 3/8	55 7/16	45 21/32	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1450	83	.....
Pratt & Whitney Aircraft Co.	Hornet T-1-C	A	Rad	9	4	D	700–2000	.....	840	1.20	6 1/4x6 3/8	6.0	151	1690	....	23 3/8	55 7/16	45 21/32	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1480	92	.....
Pratt & Whitney Aircraft Co.	Wasp, Jr. A	A	Rad	9	4	D	300–2000	.....	575	1.91	5 3/16 5 3/16	5.0	120	985	....	23 3/8	45 3/4	41 1/16	.55	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1025	39	4,860
Pratt & Whitney Aircraft Co.	Wasp, Jr. T-3-A	A	Rad	9	4	D	420–2200	.....	575	1.50	5 3/16x5 3/16	6.0	153	985	....	23 3/8	45 3/4	41 1/16	.60	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1025	85	.....
Warner Aircraft Corp.	Scarab, Jr.	A	Rad	5	4	D	90–2025	.....	230	2.7	4 1/4x4 1/4	5.2	....	301	....	17	36 1/4	29	.55	.020	prr	A1, S	1	AC	1	2M	Sc	1	Hy	Op	No	....	54	.....
Warner Aircraft Corp.	Scarab	A	Rad	7	4	D	110–1850	120–1925	270	2.45	4 1/4x4 1/4	5.2	112	422	....	17	35 1/2	27 1/2	.50	.01	prr	A1, S	1	AC	1	2M	Sc	1	Sg	Op	No	....	2	2,485
Wright Aeronautical Corp.	Conqueror	W	V-60°	12	4	DG	650–2400	650–2400	890	1.43	5 1/8x6 1/4	6.2	132	1569	....	15 3/4	39 1/16	64	.53	.025	ohc	A1, A1, S	2	BG	2	1M	Sc	2	Sg	Ec	No	1400	6	.....
Wright Aeronautical Corp.	Conqueror 625	W	V-60°	12	4	G[2]	625–2450	625–2450	965	1.60	5 1/8x6 1/4	6.3	128	1569	....	15 3/4	39 1/16	68 27/32	.53	.025	ohc	A1, A1, S	2	BG	2	1M	Sc	2	Sg	Ec	No	1465	7	.....
Wright Aeronautical Corp.	Challenger	A	Rad S	6	4	D	185–2000	191–2000	440	2.40	5 1/8x4 7/8	5.2	126	603	....	19	48 1/16	40 1/16	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	865	5	.....
Wright Aeronautical Corp.	Whirlwind 175	A	Rad	5	4	D	175–2000	175–2000	410	2.48	5x5 1/2	5.1	132	540	....	19 1/4	45	45 3/8	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	930	23	.....
Wright Aeronautical Corp.	Whirlwind 250	A	Rad	7	4	D	250–2000	250–2000	490	2.04	5x5 1/2	5.1	132	756	....	19 1/4	45	40 5/32	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1010	26	.....
Wright Aeronautical Corp.	Whirlwind 330	A	Rad	9	4	DG	330–2000	330–2000	575	1.88	5x5 1/2	5.1	132	975	....	19 1/4	45	41 11/16	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1115	21	.....
Wright Aeronautical Corp.	Whirlwind 365	A	Rad	9	4	DG	365–2100	365–2100	590	1.68	5x5 1/2	6.0	142	975	....	19 1/4	45	41 11/16	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1115	87	.....
Wright Aeronautical Corp.	Whirlwind 420	A	Rad	9	4	DG	420–2150	420–2150	590	1.40	5x5 1/2	6.1	158	975	....	19 1/4	45	42 3/8	.55	.025	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1130	78	.....
Wright Aeronautical Corp.	Cyclone 575	A	Rad	9	4	DG	575–1900	605–1900	845	1.45	6 1/4x6 7/8	5.1	138	1823	....	23 3/8	54 11/16	43 27/32	.55	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	Yes	1635	61	.....
Wright Aeronautical Corp.	Cyclone 645	A	Rad	9	4	D	645–1900	645–1900	845	1.31	6 1/4x6 7/8	5.3	146	1823	....	.....	53 3/4	41 29/32	.55	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1530	93	.....
Wright Aeronautical Corp.	Cyclone 700	A	Rad	9	4	D	700–1900	700–1900	845	1.21	6 1/4x6 7/8	6.4	160	1823	....	.....	53 3/4	41 29/32	.55	.035	prr	A1, S	1	BG	1	2M	Sc	1	Sg	Ec	No	1530	89	.....
Wright Aeronautical Corp.	Gypsy L-320	A	L	4	4	D	90–1950	96–1950	285	3.17	4 1/2x5	5.0	120	318	....	11 3/16	34 3/16	43 7/32	.55	.010	prr	A1, C	1	AC	1	2M	Sc	1	Sg	Ec	Yes	495	40	.....

A— Air cooled
Al —Aluminum
RB —Robert Bosch
C —Cast iron
Ch —Champion

com—Compression
D —Direct
DM—Dual Magneto
Ec —Eclipse
G —Geared

G[1] —5:3 epicyclic gear
G[2] —2:1 reduction gear
G[3] —3:2 reduction gear
G[4] —5:4 reduction gear
Hd —Heywood

HT—Hurley-Townsend
Hy — Holley
I —Inverted
L —Cylinder in line
Lh —"L" head

M —Magneto
NI —Nickel iron
Op —Optional
Opp —Opposed
ohc —Overhead cam

prr —push rods and rocker arms
Rad—Radial
Rad S—Staggered Radial
S.A.E.—S.A.E. mounting
Sc —Scintilla

Sid —Scintilla — Dual Magneto
Sg —Stromberg
S —Steel
W —Water cooled
Z —Zenith

Note: Cylinder construction: first symbol designates head, second — walls or waterjacket, and third — sleeve, if any.